MASTER THESIS

WOOD AND EARTH AS BUILDING MATERIALS FOR THE REDEVELOPMENT OF ZEITZ

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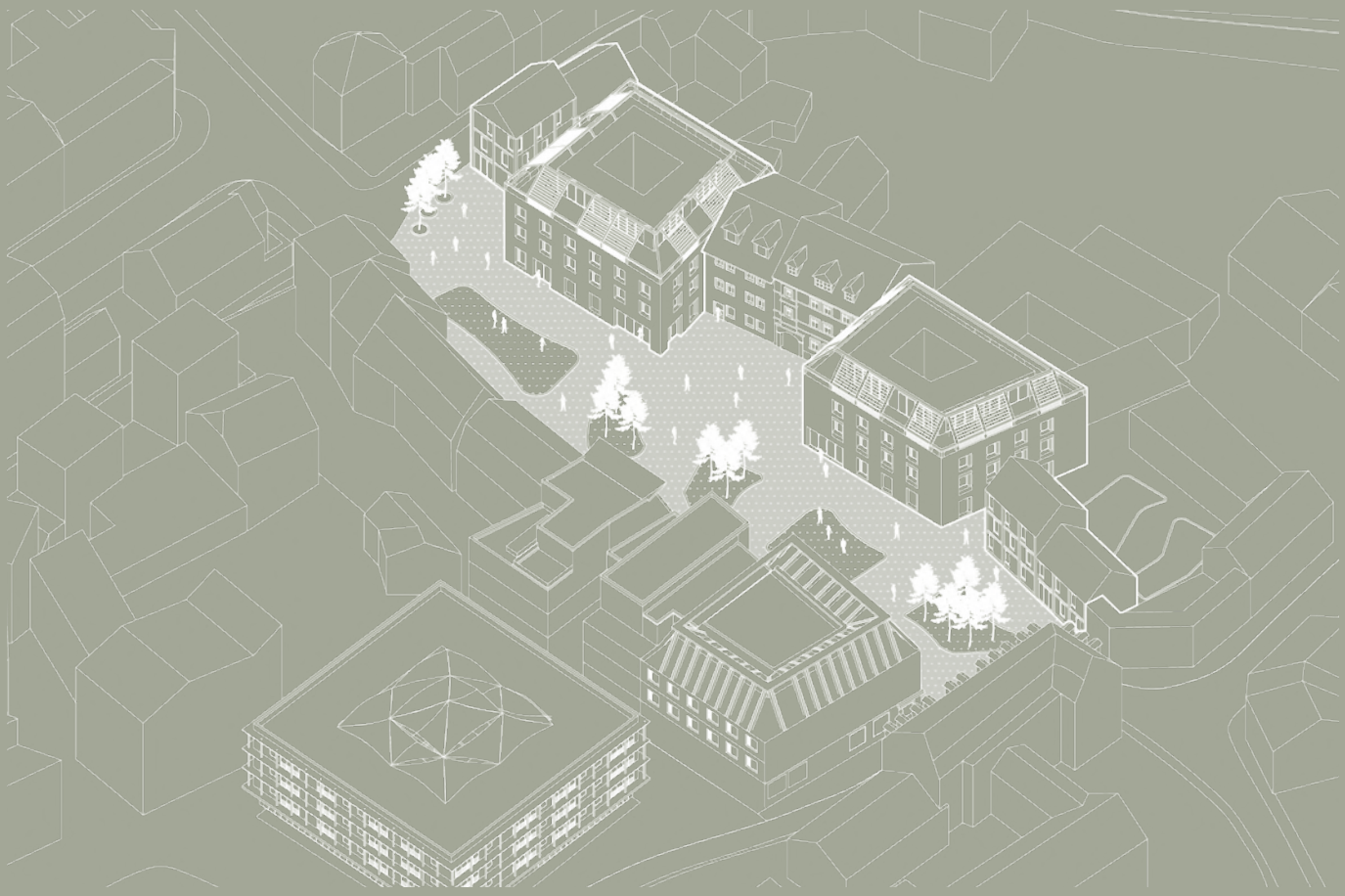
Advisor: Prof. Johannes Kister

Second Advisor: Prof. Peter Ruge



Summer Semester | DIA | HS Anhalt | 2023

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This master thesis explores the potential of using nearby materials to regenerate the Der Brühl area in Zeitz, Germany. The town was faced with a declining population problem due to migration to larger cities, therefore the town needs a transformative intervention to bring back to life its social, economic, cultural, and physical fabric.

The analysis studies Zeitz's spatial, cultural, and historical context, analyzing its architectural heritage and identifying contemporary challenges. Drawing on the principles of sustainable design and community engagement, the project proposes the conversion of the street Der Brühl and the creation of new spaces and areas to promote the use of the public space and the arrival of new users and residents.

The research employs a mixed-methods approach, combining literature review and site analysis to generate an informed design as a solution for the problem mentioned above. It explores design strategies that facilitate the use of nearby materials, in this case, timber and earth, to reduce the environmental impact and respect the town's identity while supporting local producers and workers, thus creating a positive impact on the economy.

As one of the strategies, the use of various programmatic options such as markets, coworking spaces, shops, and housing, become a potential solution to activate the space and enhance social interactions. These uses are carefully thought of to rise the number of residents of the town and to create a place that attracts different types of users to revitalize the public space.

Through the design process, the project aims to enhance social cohesion, support the local business and economy, and improve the living environment for residents and visitors alike. It highlights the importance of designing for the community and preserving the culture of the area in new urban renewal initiatives.

The findings of this thesis contribute to the broader discourse on urban revitalization and the potential of these as catalysts for positive change in small communities. The research aims to provide valuable insight into how the problem should be approached and set an example for future interventions.

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Wood and Earth: nearby building materials for the redevelopment of “Der Brühl”, Zeitz

Nearby Materials Master Thesis
Advisor: Prof. Johannes Kister

Architecture has always been a very important aspect of human development and progress which helps society to shape the physical environment to fulfill certain needs. Nevertheless, as society progresses, so does architecture as different needs and problems arise, and current situations are demanding that it evolve to become more sustainable and innovative in order to battle the increasing problem of climate change.

The nearby materials studio is a thesis research space dedicated to finding useful local resources to create an urban intervention that is both aesthetically pleasing and environmentally conscious in the town of Zeitz, Germany. At the same time, the investigation aims to set a precedent for future interventions in historic towns and cities by proving the feasibility of using locally sourced materials for contemporary architecture.

The town of Zeitz was once an important industrial center that represented the technological upheaval of the time and was a prosperous community. Because of many factors, including the war and other political circumstances in Germany, the town that was once progressing started to decay. The different industries were almost all gone, and the inhabitants of the town were forced to leave in these situations in order to look for better opportunities and conditions in bigger cities. The once shining town became forgotten and started to decay until what it is today, an area full of history and opportunities which are waiting to be exploited.

Therefore, the focus of this master thesis is to explore the potential of using nearby materials to create an urban intervention in Zeitz, which answers to a specific spatial and historical context, while promoting the redevelopment of the town center, specifically in the area “Der Brühl” and influencing the rest of the surroundings to also apply these techniques in future projects.

Key words: sustainability, Zeitz, rammed earth, timber, redevelopment, urban intervention

Figure 1: Postcard Zeitz im Burgenlandkreis, Rothe Straße, Altstadt. (Unknown, 1920).

CHAPTER 1
PROLOGUE

1.1 Objective

1.2 Research object and methodology

1.1 Objective

The objective of this thesis is to study the possibility of using nearby materials in the design of an urban intervention in Zeitz, Germany. The project aims to contribute to the revitalization of the center of the town, specifically "Der Brühl", which has suffered a severe decline in its population in the past decade.

By understanding the historical and physical context, materials like timber or earth are used as building techniques for an urban intervention in the above-mentioned area. This proposal not only showcases the potential of utilizing locally sourced materials in architecture but also creates a unique and urban space that is aesthetically pleasant, technically efficient and maximizes the social and economic benefits for the community.

This objective is reached by researching concepts like sustainability and urban regeneration, constructive methods like timber and earth construction, and studying and analyzing the history of the town and the physical context of the area.

The ultimate goal is to demonstrate the feasibility of using nearby materials in contemporary architecture by achieving a comprehensive understanding of the benefits and challenges associated with the use of locally sourced materials in a complex reality like Zeitz and to propose a sustainable and innovative solution for the urban intervention of "Der Brühl".

Structure of the investigation
The proposed area is studied in order to identify contextual characteristics like social aspects, historical conditions, and physical conditions, among others. Afterward, the materials are chosen based on the availability of resources in the area. These materials are studied in order to achieve an accurate proposal. The conceptual bases of the project are showcased with diagrams and the design process is explained. Later on, the proposal is finally presented with renderings, plans, and diagrams. Lastly, the author presents conclusions and the resources used for the investigation.

1.2 Research object and methodology

The research object of the thesis is to create a fully functional, aesthetically enjoyable, and socially responsible space that contributes to the revitalization of the town center in Zeitz, Germany; while promoting sustainable practices and the use of local materials. The town has been a victim of decay due to the decreasing numbers in its population because of the migration of its inhabitants to bigger cities. The plot is located in the old city center of the town in the street known as “Der Brühl”. The objective of the project is to revitalize the area by proposing uses that attract different types of people and offer new activities to catch the attention of both investors and various target users. Additionally, nearby materials must be used for the proposal to offer a sustainable design that facilitates the development of the project. The research phase of the investigation aims to identify the materials of the area and choose those that are suitable for the proposed buildings, to develop a functional design that manages to improve the current situation. Furthermore, the economic, social, and cultural factors that led to the decay of the town should be analyzed to be able to calculate the potential impact of the project in the context. To conclude, the ultimate goal is to create a functional and sustainable project that is beneficial for the community and that revitalizes the city center of Zeitz with locally sourced materials.

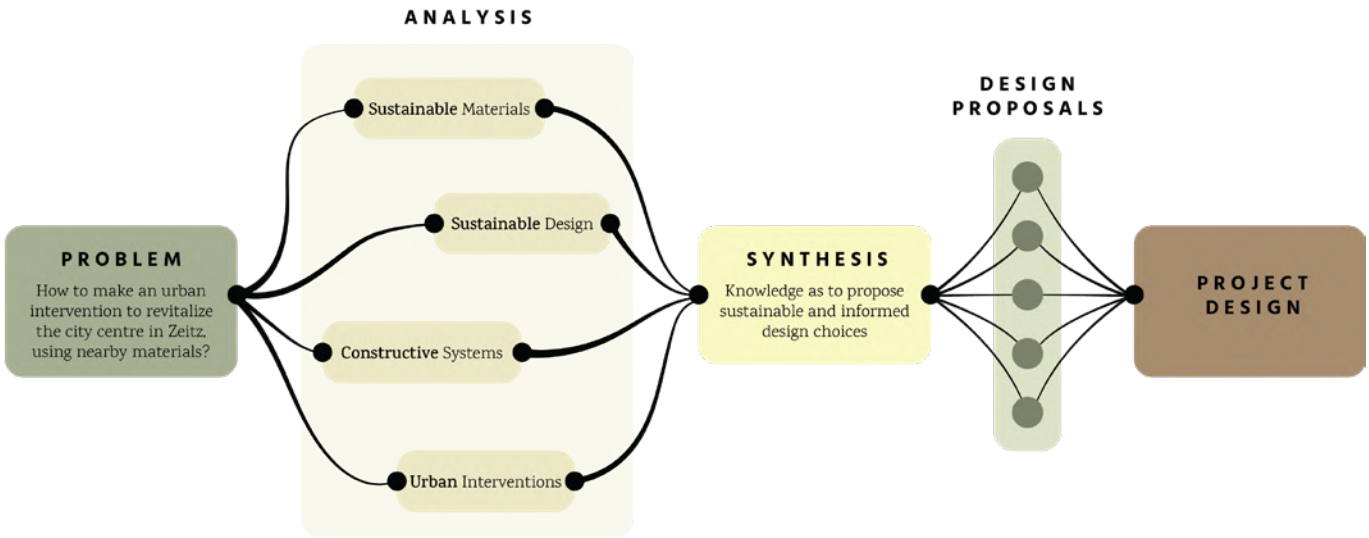

Figure 2: diagram of the methodology of the investigation. By author.

Figure 3: 1920-1930 Bruhl. (Cramer, K., Museum Schloss Moritzburg Zeitz 2021)

Figure 4: GDR Times 1960-1970. (Andräs, A. 2022).

CHAPTER 2
CONTEXT

2.1 Theoretical context

2.2 Historical context

2.3 Spatial context

Chapter 2 focuses on the contextual conditions where the research takes place.

It starts with a theoretical context in which the concepts on which the research is based are defined. The developed terms are urban design, redevelopment, nearby materials, and sustainability. They are explained with definitions and additionally, on how the concept is understood for the development of the investigation.

Secondly, the historical context is explained. The first approach is a brief history of the town of Zeitz, followed by a timeline of the most relevant events that shaped the town into what it is today and graphics about the change of the population in time.

Finally, the spatial context is developed. There is a brief explanation about where the town is located and about the chosen plot inside the town, followed by an old plan of the area and compared with the proposed urban intervention of the area of Der Brühl.

The conclusion of the chapter consists of images of the actual condition of Der Brühl, taken during a site visit.

2.1 Theoretical context

Urban design: concerns the physical form of cities, buildings, and the space between them. The relationship between the physical form of the city and the social forces which produce it. It focuses on the physical character of the public realm but is also concerned with the interaction between public and private development and the resulting impact on urban form. (Greed, C., Roberts, M., 2014)

Redevelopment: the act or process of changing an area of a town by replacing old buildings, roads, etc. with new ones. The improvement of an area that is in bad condition, esp. an area of old buildings in a city. (Cambridge Dictionary, 2023)

Nearby materials: refers to locally sourced materials that require minimal intervention in order to be able to be used in an architectural project. Understanding the physical context in which a project is in order to find in it which resources can be transformed into building materials for construction.

Sustainability: the quality of causing little or no damage to the environment. The idea is that goods and services should be produced in ways that do not use resources that cannot be replaced and that do not damage the environment. It has three scopes, explained in the following diagram. (ESG /Escola Superior Gallaecia, 2014)

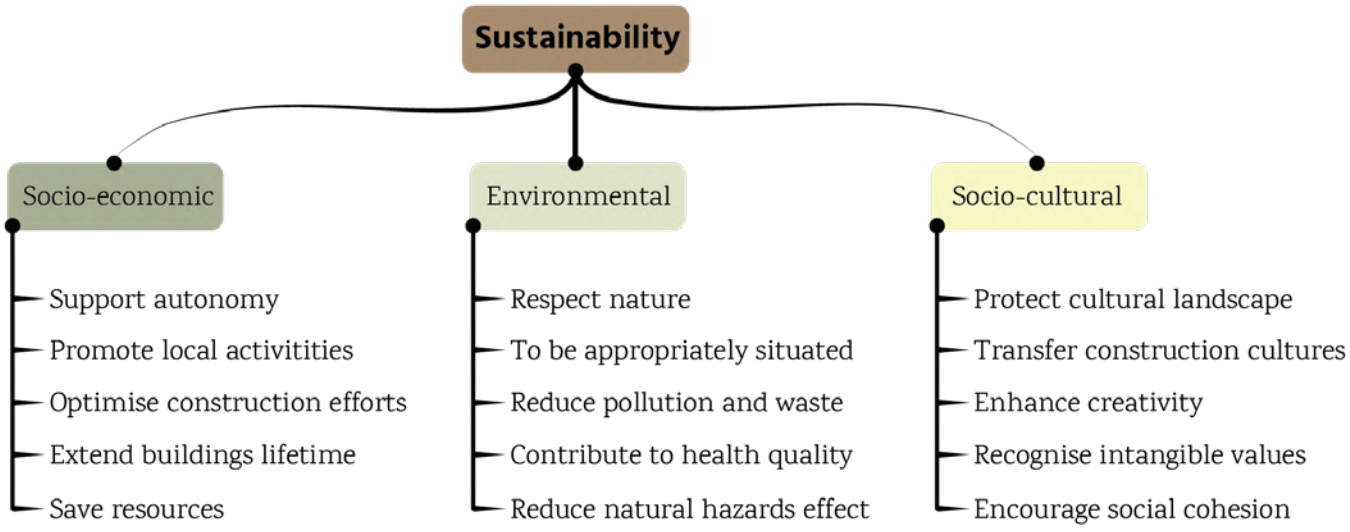

Figure 5: Scopes of sustainability. By author.

2.1.1 Sustainability: scopes

The different scopes of sustainability are extensively explained in the document Lessons from Vernacular Heritage to Sustainable Architecture: Versus. The three scopes, as defined in the document are the following:

1. Environmental: this scope addresses the human capacity of intervention in order to decrease and even avoid negative impacts on the environment, which is very sensitive to changes. Human intervention is able to integrate nature and bioclimatic features, control the production of pollution and waste, preserve health, and prevent natural hazards impacts. (ESG /Escola Superior Gallaecia, 2014, pp. 17-27)

2. Socio-cultural: the sense of belonging, of identity, of personal and community development. This scope tries to gather all social and cultural positive impacts observed on vernacular heritage. It concerns the protection of cultural landscapes, the transmission of construction cultures, the capacity to stimulate creativity, the recognition of cultural values (tangible and intangible), and the reinforcement of social cohesion. (ESG /Escola Superior Gallaecia, 2014, pp. 29-39)

3. Socio-economic: the capacity of reducing the efforts invested during the construction process, the building performance, the maintenance of buildings, and all the impacts that contribute to an improvement of living conditions. Here, the concept of effort and work replaces the idea of cost, especially in contexts where no capital-intensive systems were implemented. Vernacular solutions encourage autonomy and local activity, optimize construction efforts, extend the lifetime of the building, and save resources. (ESG /Escola Superior Gallaecia, 2014, pp. 41-51)

2.2 Historical context

In the case of Zeitz, it is relevant to look back into the history of the town to find events that may have influenced and shaped the reality of the town nowadays.

Zeitz is a town with an extensive and interesting story. The relevant events that shape the town into what it is today started with the town being a residence for bishops, which put the town on the map. In the 6th century, the area was officially founded as a farming town. It wasn´t until the 10th century that it became valuable due to its strategic location useful for the military, which was in between crossroads of important trade routes.

The determining moment that shaped Zeitz into what it is today is the industrial revolution. It developed into a modern city thanks to industries like piano and machinery construction, the creation of the baby carriage, and sugar production. Later, the mining of brown coal started. Due to the rapidly growing industries, during the 1800´s the population and area of the city increased drastically.

Like many other areas in Germany, Zeitz became a target of air raids during World War II, which deteriorated drastically the physical condition of the town. After the war, the town was assigned to the Soviet occupation zone.

For many years after, Zeitz had industries that were relevant for the Halle and Leipzig area, like chemical industries and mining. These industries promoted the development of the city.

During the GDR times, there was an increase in the population of the town due to industrial success. As the population rose, the need for housing became more urgent thus creating various residential areas. This was the last boom of growth and development of the town.

During the past fifteen years, the town became less important and as industries left the area, the people of Zeitz started to go to bigger cities in search of better opportunities. Since 2017 the inhabitants' trend shows that the average annual variation is 1.42%. (Stadt Zeitz, Unknown).

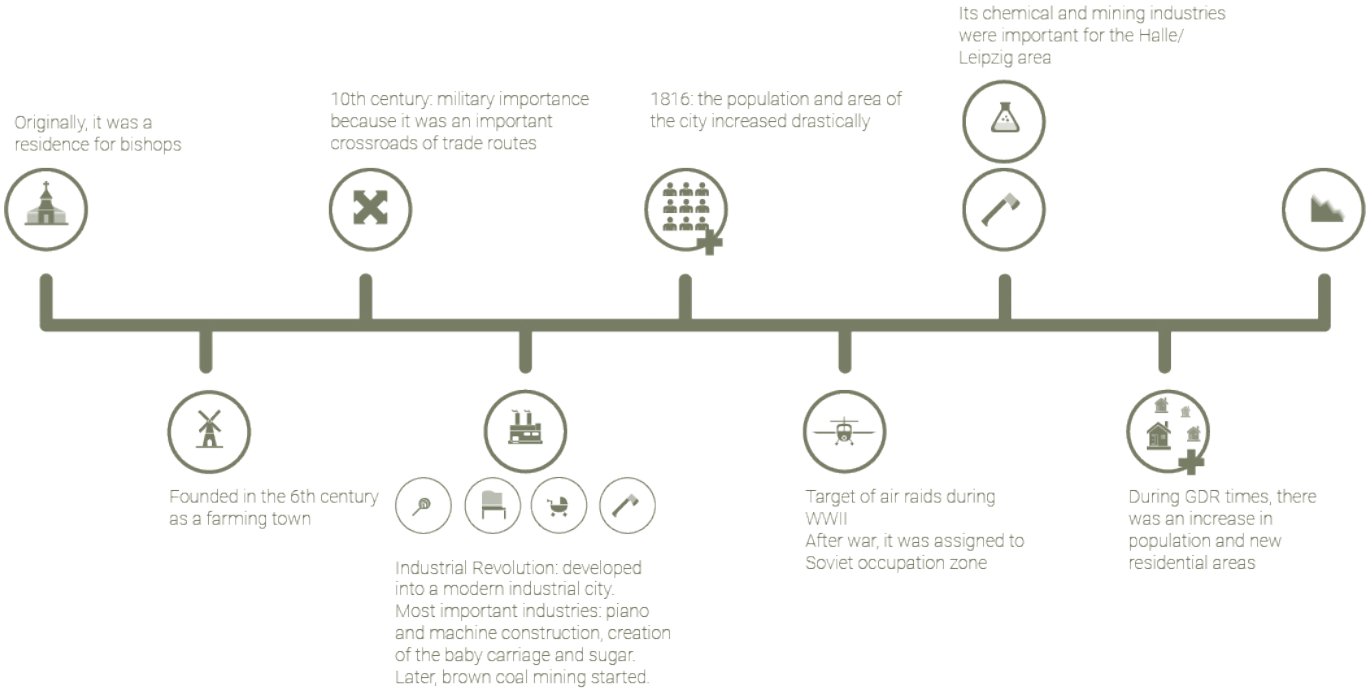

Figure 6: Timeline of the history of Zeitz. By author. (Stadt Zeitz, Unknown).

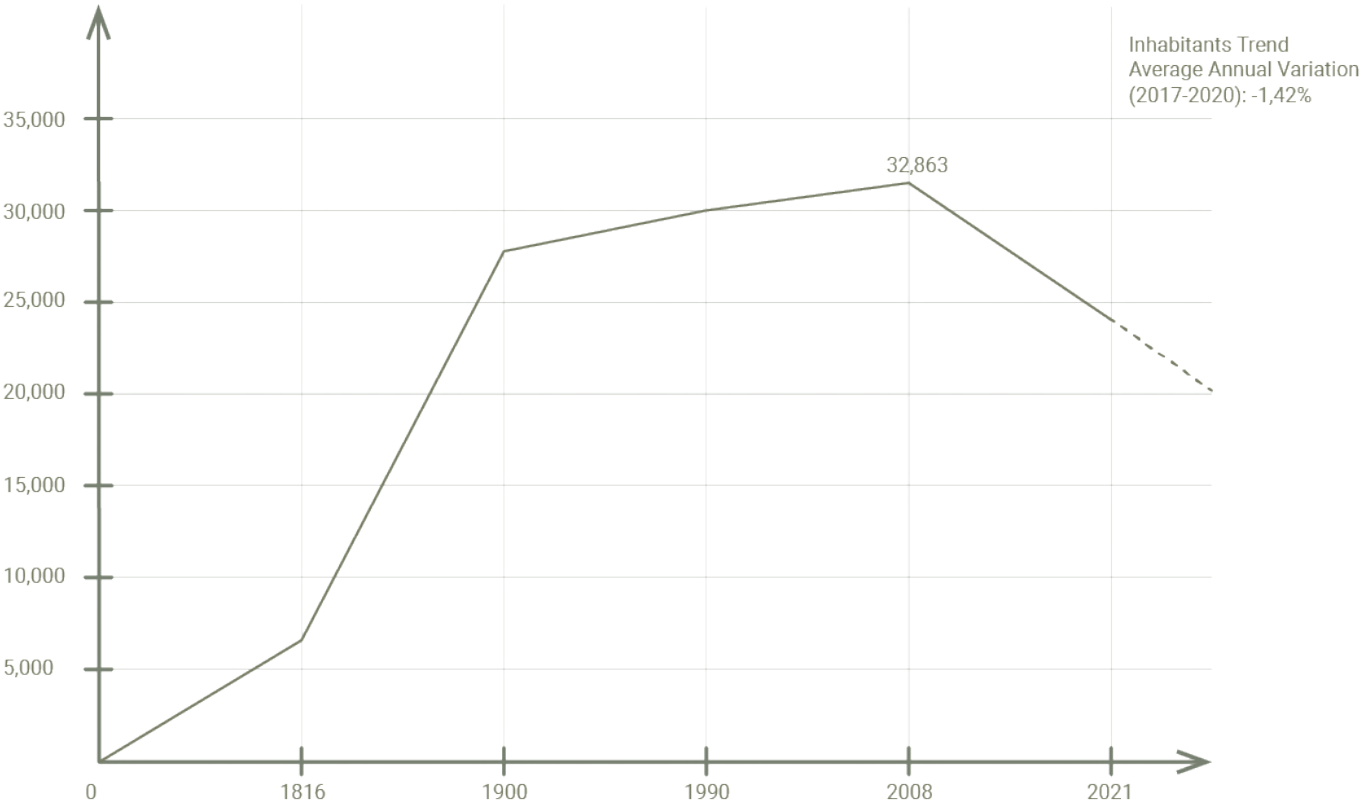

Figure 7: Inhabitant trends, variation of population. By author. (Citypopulation.de, 2022)

2.3 Spatial context

This research is centered around the town of Zeitz, in Sachsen-Anhalt, Germany. The town is mainly built in the typical German construction of half-timbered houses, combined with more modern buildings due to the historic development during the decades. This town, rich in history and architectural heritage, has encountered the challenges of a declining population and migration to larger cities. As a response to these circumstances, a holistic urban renewal project is proposed aiming to revitalize the village center and create a vibrant community hub. The project is specifically located in the city center, in a street known as Der Brühl, which has a combination of traditional buildings and contemporary buildings. There is a first intervention planned for the East of the street and this project aims to develop the Western side, as a compliment to round up the design. The spatial context demands thoughtful design solutions that not only activate the street but also ensure its functionality, and integration with the existing urban fabric. With a focus on sustainability, the investigation aims to source materials from the local area, establishing a strong connection to the village's identity and reducing the environmental impact of the intervention.

Figure 8: Location of the plot in Zeitz. By author.

Figure 9: historical urban distribution of Der brühl.
The dotted line shows the old line of the buildings and how the street was defined originally.
By author.

Figure 10: actual condition of Der Brühl.
Today, the street has been intervened as it is shown in the plan, with a street for cars in the center, gardens, and pedestrian areas on the sides. The existing buildings are both modern and refurbished but there are a couple of historical decayed buildings too. Most of the area is vacant and is currently being used as parking lots.
By author.

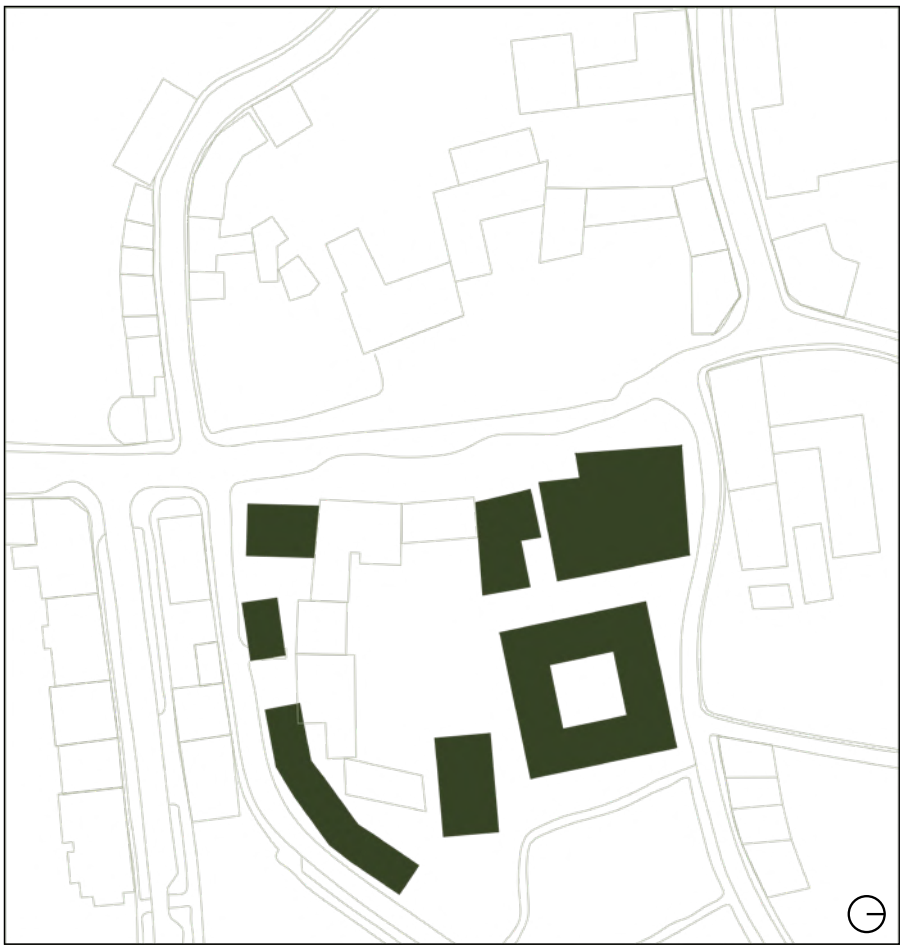

Figure 11: the first stage of the new development.
This plan was designed by KSG Architekten, and guided by Prof. Johannes Kister.
This would be the first development of the area in which there is no major change of the street itself but the intervention is focused on developing the empty plots which have a lot of potential and are underdeveloped.
By author.

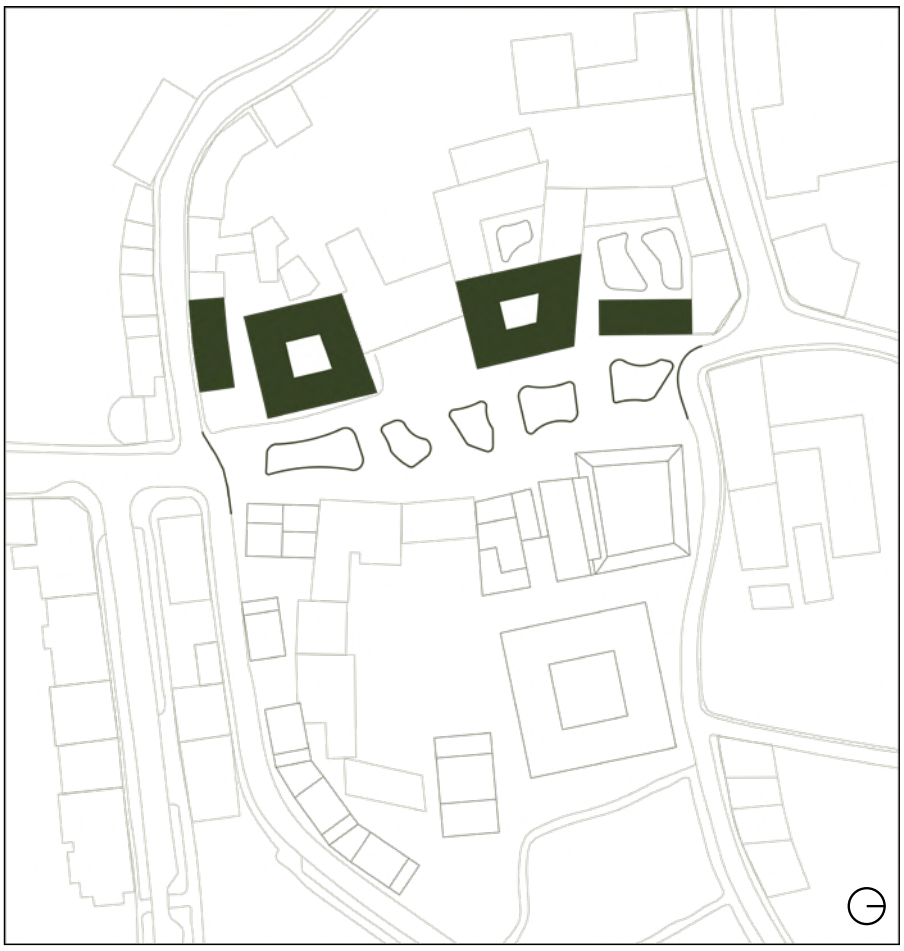

Figure 12: final proposal of Der Brühl.
This is the last stage of the urban intervention.
The street becomes pedestrian-only in order to give strength to the public space and highlight its importance for the proposal.
The idea of internal courtyards is a result of continuing the design language of the first stage of the intervention. Additionally, the smaller townhouse typology is also an answer to the first proposal and to the surroundings.
By author.

Figure 13: Photograph of the plot. By author.

Figure 14: Photograph of surrounding buildings. By author.

Figure 15: Photograph of the area. By author.

Figure 16: Photograph of surrounding buildings. By author.

Figure 17: Photograph of surrounding buildings. By author.

Figure 18: Photograph of surrounding buildings. By author.

Figure 19: Closeup of a sample of earth. By author.

CHAPTER 3
MATERIALITY

3.1 Prefabricated rammed earth panels

3.2 Timber construction

3.3 Where does it come from

This Chapter contains the research on the nearby materials near Zeitz and explains the ones that are used for urban redevelopment.

As an introduction for each material, a brief historical context is presented as it is relevant to understand how these materials have been used in the past and how the techniques have evolved through the years.

The first material chosen is Rammed Earth and the question of WHAT is it? and HOW does it work? are developed and answered. All the information gathered in the theoretical and constructive research to answer these questions ends up in the question of WHY is it chosen? with the objective of highlighting the benefits of using this material and the reasons behind its use.

The second material chosen is Timber. The process is the same as in the Rammed Earth, WHAT is it? and HOW does it work? conclude in the question of WHY is it chosen? The benefits of using timber and the reasons why it was chosen for this proposal are stated.

Finally, as the topic is the use of nearby materials as building materials for an urban redevelopment of Zeitz, the materials should be close to the town. This is explained with maps of where the materials are found and the distance from the plot.

Figure 20: Closeup of a sample of earth. By author.

3.1 Prefabricated Rammed earth panels

Historical context

Humanity has been using the earth as a building material for thousands of years. In Germany, there are more than two million buildings that were made with earth and one-third of the human population today resides in earthen houses. (Minke, G., 2006, pp. 11)

In dry climatic zones where resources are scarce, construction techniques developed with the available material: earth. Buildings were covered in mud bricks vaults or domes without frames or support during construction. In Germany for example, wood was available, and earth was used as infill in timber-framed houses or as a cover for walls to seal them. The oldest example of mud brick walls in northern Europe is found near Lake Constance in Germany. Earth techniques are more commonly known in old constructions like forts in Spain, in Central and South America in pre-Columbian cultures, and in Africa in many early mosques. During the medieval period, earth-building materials were used throughout Central Europe as infill in timber-framed buildings and as a cover for straw roofs.

The rammed earth technique, for example, was widely used from the 15th to 19th centuries. They developed this technique, and it was later spread to other European countries as it was recognized as the most advantageous earth construction method. In Germany, specifically, the oldest inhabited house with rammed earth dates from 1795. There are other historical examples that are still standing today like a house in Weilburg, built around 1828. (Minke, G., 2006, pp. 12-13)

Nevertheless, the use of the earth as a material for construction has declined significantly since the industrial revolution, as the industrialized production of building materials increased at the end of the 19th century. Constructing with earth became common again for short periods of time after the two world wars, forced by the scarcity of resources because of the devastating consequences of war. After the building industry was reinstated, housing became a priority and it translated into a rationalized architectural typology of high-rise buildings made with prefabricated elements which made the construction cheaper and faster. Consequently, there is a loss of earthen-building expertise.

Consequently, the West German DIN regulations for earth construction were withdrawn in 1970. After that, concrete

prevailed and the use of earth declined. Labor became hard to find as the transmission of knowledge of the building techniques was neglected.

With the increased awareness of developing ecological and sustainable building solutions since the 1980s, the interest in the construction of earthen materials has increased, therefore creating a need for professional training in earthen building techniques. Additionally, there has been an increase in industrialized production of earthen building materials.

In 1998 the Lehmbau Regeln (German earthen building restrictions) was established, it provides a basis for accepted standards for executing building works with earthen materials. (Schreckenbach, H., 2004, pp.28)

What is it?

Earth as a building material comes in many different compositions and can be processed in various ways. Clay or loam, as they are technically referred to, can be used in many ways from rammed earth (compacted within a wood formwork), soil blocks (compressed unbaked bricks), mud bricks, or adobe (handmade unbaked bricks). It is a mixture of clay, silt, sand, and sometimes aggregates that improve its physical characteristics and behavior like gravel or stones. (Minke, G., 2006, pp. 7)

The loam is not a standardized building material as it depends on the site where it is dug out. It can be composed of different amounts and types of clay, silt, sand, and aggregates. This translates into different characteristics from site to site which requires specific preparation for a specific application. Therefore, it is necessary to make a previous study of the type of loam available for construction to find the correct mixture to improve the characteristics of the material.

Earth materials need a moisturizing agent to activate their binding strength, water is this agent. Therefore, loam mixtures shrink when dried and cracks may occur. The shrinking

percentage depends on the specific technique used and the mixture itself. To minimize this effect, clay and water content can be reduced and the grain size distribution or the use of additives can help too. These earthen materials are also sensitive to water so they must be sheltered from rain or frost. Different techniques can be used to protect the material like roof overhangs, damp-proof courses, and surface coatings, among others.

On the more positive side, the loam is a breathable material that can absorb humidity faster than any other material without losing stability which allows it to balance the indoor climate. On the other hand, loam stores heat so in climatic zones with high diurnal temperature differences, or where it becomes necessary to store solar heat gain by passive means, loam can balance indoor climate. Additionally, it saves energy and reduced environmental pollution by using it during the preparation, transport, and handling of the material, only 1% of the energy when compared to baked bricks or reinforced concrete. As it is a material that requires almost no modification when used as a building material, it produced almost no pollution and as the material is not baked, it can be recycled after the lifespan of the building is completed only by mixing it again with water. Another positive aspect is that soil with a high percentage of clay is usually found on site meaning the same plot material can be used for the construction of the building itself. Finally, when using timber and loam in construction, the wood is protected from humidity damage or plagues because of the humidity control characteristics of the material. (Minke, G., 2006, pp. 13-16)

Why rammed earth panels?

- Loam is a breathable material that absorbs humidity without losing stability
- Balances indoor climate with its thermal capacity, it absorbs and re-radiates heat to control temperature fluctuations in rooms
- Saves energy and reduces environmental pollution during the preparation, transport, and handling of the material for construction
-The primary energy use for their manufacture is low
- It can be recycled or returned to earth after the lifespan of the building is completed because of the little processing it needs for construction
- The material is usually found on site
- Controls indoor humidity and protects other building materials from water/ humidity damage or plagues
- Works as a shield against high-frequency electromagnetic radiation
- They are physically aesthetic and attractive by being naturally warm and because of their color
- Very durable materials when correctly maintained

How does it work?

Due to the intricate process of making rammed earth walls which requires expertise and a lot of time, and the sensitivity of the material to atmospheric conditions, new technologies have been developed in order to make the process of building with earth more efficient and productive to make sure it is competitive in the industry when compared to other techniques or materials like concrete or burned bricks, which often have shorter construction times and is more efficient.

Therefore, the idea of constructing with larger prefabricated elements has been developed. This idea comes from the need of producing the parts in controlled environments, automate processes to make them more efficient, and reduce construction times. These panels are usually used for non-load-bearing elements, they should be made of lightweight loam. (Minke, G., 2006, pp. 30-32)

When used in modern constructions, loam materials must fulfill general requirements like noise insulation, fire safety, stability, and thermal insulation. In Germany, earthen building regulations called Lehmbau Regeln describe the main classes of earthen products available. Earthen materials can be used for different types of elements needed in construction. It can be used as floors, load-bearing walls, freestanding walls, ceilings and roofs, dry boards, or cladding and plaster. Different techniques allow the material to fulfill all these possibilities, like rammed earth, mud, clay straw, loam filling, earth mortar, earth blocks, or earth panels. The only limitation of earth materials, however, is that they can't be used for the construction of footings and foundations.

The flexibility of these materials allows for the use of hybrid construction by combining earth materials with concrete or timber. However, the cost of building with this material is a huge demotivating reason when building new structures. Nevertheless, as the use of earthen building materials grows more widespread, prices will become more attractive as new products are developed and more material producers or constructors increase. (Sauer, M., Kapfinger, O., 2015, pp.65-73)

The envelope that surrounds us should be able to breathe and diffuse in the same way as our bodies.

- Martin Rauch *(Kapfinger, O., Sauer, M., 2015, pp.84)*

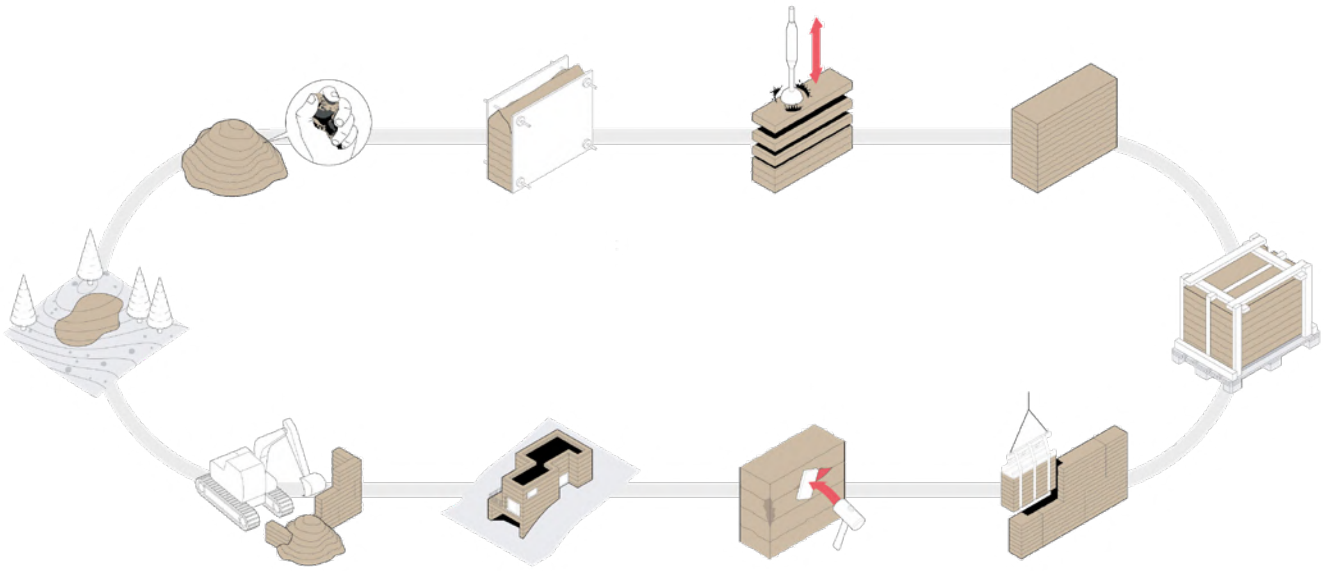

Figure 21: Diagram of Earth Cycle. (Erden.at., Unknown)

References

Swiss Ornithological Institute

Location: Sempach, Switzerland
Architects: MLZD, Martin Rauch
Year of construction: 2015

Figure 22 - 23: photos of the project. (Jaquemet, A., 2015).

Ricola Kräuterzentrum

Location: Laufen, Switzerland
Architects: Herzog & de Meuron, Martin Rauch
Year of construction: 2014

Figure 24: photo of the facade of the project. (Moser, C., 2010-2014).

House Rauch

Location: Schlins, Austria
Architects: Martin Rauch, Roger Boltshauser
Year of construction: 2005-2008

Figure 25-26: photos of Haus Rauch. (Bühler, B., Rauch, M., Unknown).

Alnatura Campus v

Location: Darmstadt, Deutschland
Architects: Hass Cook Zemmrich Studio 2050, Martin Rauch
Year of construction: 2016-2017

Figure 27-28: photos of the Alnatura Campus. (Hass Cook Zemmrich I Studio 2050, 2017)

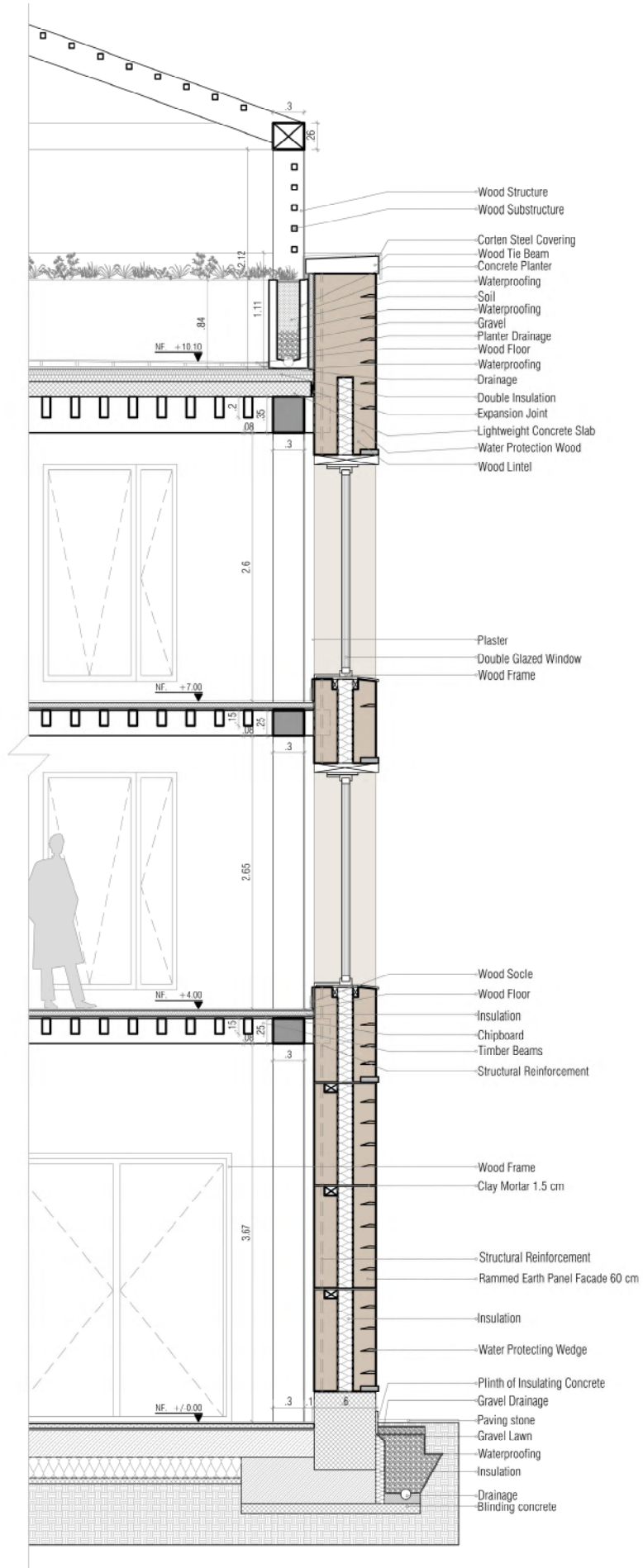

Figure 29: Detailed cross section of the facade. By author.

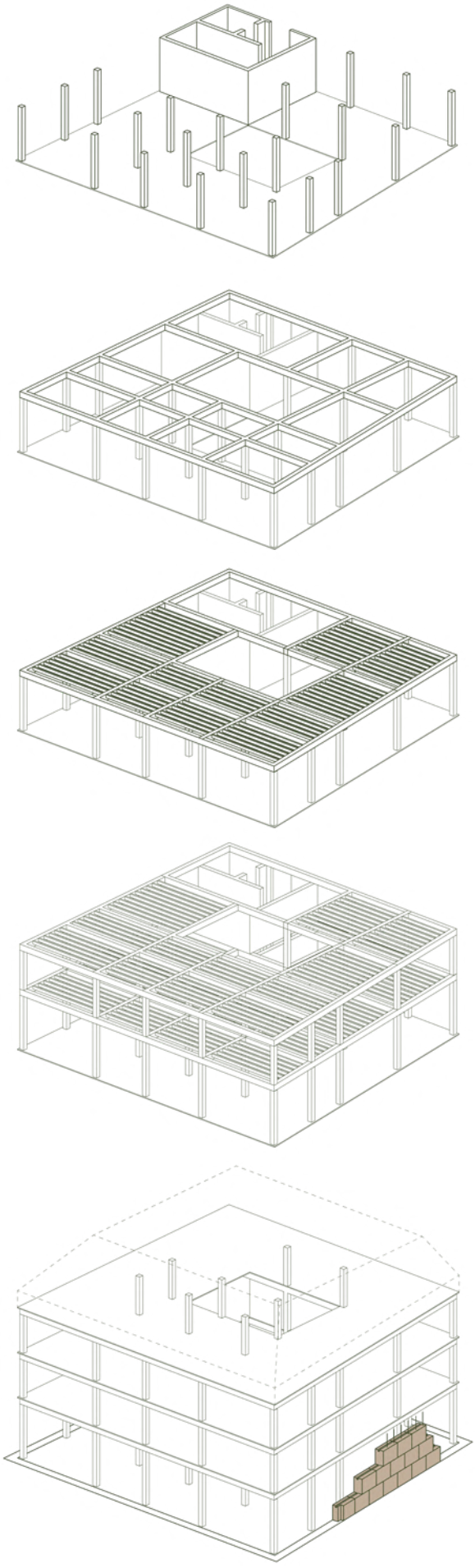

Figure 30: Diagram of the constructive system. By author.

Figure 31: Closeup of a timber structure. (Kaufmann, H., Krötsch, S. and Winter, S., 2018)

3.2 Timber construction

Historical context

Timber buildings have been constructed since antiquity. Log construction is one of the oldest methods of timber construction and has been built since the Neolithic Age. In regions with abundant forests, where there was a lot of wood, it became the predominant building material and there is deep historical knowledge and manual skills that have developed through time. It has been used in important cultures like the traditional Chinese and the Japanese since the 6th century, which mastered the art of timber construction and developed new building techniques that resulted in high quality architectural master pieces that are still standing today. During the modern era, timber was replaced with materials like concrete or steel when used for more than 2 stories high buildings.

In Europe, half-timbered construction was the predominant method used to build buildings (specially in central European countries) and it was used from the Middle Ages until the late 19th century. This constructive method was a revolution in timber construction as it used a system that allowed individual load-bearing elements to be replaced easily without risk of damaging the rest of the structure, a common problem found in older methods, or the ones used in other cultures. This allowed the buildings to last several hundred years and resulted in a lot of knowledge and skill in relation to structural timber preservation that is still used today.

During the modern era, concrete and steel dominated the construction industry.
Timber no longer played a significant role in construction as the other materials were easily available and offered other benefits like non-flammability.
Because of a series of technical innovations, timber has undertaken a new direction and thanks to the global environmental development, especially global warming, there has been an increased use of timber construction in central and northern Europe.

Recent developed projects have proven that timber construction can meet all the requirements of stability and flammability while reducing the impact of the construction industry in the environment. From smaller buildings to multi-story buildings, timber can be used in many ways. It certainly is a material for the future. (Kaufmann, H., Krötsch, S. and Winter, S., 2018, pp. 10-13)

What is it?

Nowadays, 30% of the Earth´s land surface is covered with forests, reaching 4 billion hectares. The global forest cover has been shrinking for decades because of slash-and-burn farming, agriculture, and the illegal harvesting of wood. Even though 4.3 million hectares of new forests are planted every year, there still are approximately 3.3 million hectares lost. Anyway, timber is still one of the most important renewable resources and one of the three most used materials for construction, energy production, etc.

The timber industry is divided into the wood industry, wood-working trades, and lumber trades. It is used for prefabricated timber construction, industrial timber construction, carpentry, joiners, and the furniture industry, among others. In Germany, with the current forest development and timber resource modeling, there is a forecast of having forests and enough wood for the next 40 years. (Kaufmann, H., Krötsch, S. and Winter, S., 2018, pp. 15-16)

Why timber construction?

"The construction sector is responsible for a large proportion of our consumption of resources as well as for our greenhouse gas emissions, with the construction of buildings consuming around 40% of all energy and materials. This sector also produces 36% of all waste. This creates a need for planners to increasingly focus on environmental aspects in designing and planning buildings."
(Kaufmann, H., Krötsch, S. and Winter, S., 2018, pp. 24)

Climate change is a rising concern for humanity nowadays. To reduce the CO2 levels in the atmosphere it can be done by either lowering the emissions or extracting the CO2. Wood can contribute to climate protection because it is a renewable resource, and it can absorb CO2 while also reducing emissions. When the wood comes from sustainably managed forests, it can act as protection for the climate as at the end of the production cycle the use of wood reduces greenhouse gas emissions (CO2).

The process starts when the forest absorbs CO2 from the air to be used in photosynthesis, later on, it stores carbon and releases oxygen into the air. Additionally, trees balance the

temperature of their surroundings and improve air quality. German forest acts as a CO2 sink to remove around 58 million tons of this gas from the atmosphere every year.

When wood is used as a building material, the carbon that was absorbed before remains bound in the products. To make the process renewable, new trees are planted to replace the ones harvested and these new trees continue to absorb CO2. Additionally, timber products and constructions consume less energy during production when compared to other materials like cement, aluminum, plastic, or steel. Furthermore, wood can act as a substitution for fossil fuels and energy-intensive raw materials like coal and natural gas. Finally, one of the main reasons why wood is a renewable source and a good material for construction is that it can be recycled several times and processed into new products or used to produce energy when the wood can´t be reused or recycled, therefore keeping the material chain for as long as possible. (GD Holz, 2023)

Another reason why this material is ideal for sustainable constructions is that it generates a healthy and attractive indoor climate. Wood is naturally appealing to our eyes as it is considered a warm and calming material. It helps to regulate interior climates because wood absorbs moisture from the interior air and gradually releases it again to keep comfortable interior atmospheric conditions. Finally, it is a healthy material that can have low pollutants released into the air, at levels that are not significant to affect the health of the users. (Kaufmann, H., Krötsch, S. and Winter, S., 2018, pp. 35)

To conclude:

- Renewable resource
- It absorbs CO2 and reduces the emissions
- It comes from sustainably managed forests which improve air quality
- The absorbed CO2 remains bound in the products even after construction
- New trees are planted to replace the harvested ones and this way the absorption cycle continues
- Consumes less energy during production
- It can be reused, recycled, and processed several times into new products
- When its reusable cycle is over, it can be used to produce energy
- Generates healthy indoor climate
- Is warm and appealing in appearance

How does it work?

There are different solid wood and wood-based materials used in industrialized timber processes. The solid wood can be improved for construction by drying the logs and the wood-based materials are made by bonding wood either with wet or dry processes and adhesive. These materials include planks, sheets, chips, or fibers.

Wood can be either softwood or hardwood and these different structures are used for different purposes. Various bonding agents can be used to help press sheets, chips, or fibers together to form wood-based materials, and other substances can be added to improve the performance of the materials under different stresses like the load-bearing capacity, strength, thermal conductivity, fire resistance, bending capacity, among others. (Kaufmann, H., Krötsch, S. and Winter, S., 2018, pp. 18)

As mentioned before, different types of wood products can be used in diverse situations to have a full-timber structure without the need of using additional materials. Solid softwood and hardwood timber can be used for structural purposes, combined with double laminated beams to give more resistance to the structure, and laminated materials like Cross Laminated Timber can be used for non-load-bearing walls, formwork, interiors, or furniture. If wood is also used in the exteriors of a building, materials like veneered plywood can offer weather protection and Porous Panels can make the facades more windproof. (Kaufmann, H., Krötsch, S. and Winter, S., 2018, pp. 20-23)

When talking about how this material can be constructed there are traditional ways which consist of panels, frames, or solid timber that result in different types of structures and facades. But nowadays there are hybrid constructive methods by combining various building elements, allowing customized solutions that result in more design freedom. Additionally, other materials can be used too, and this allows that the different properties of each material can be combined to optimize an overall system. This hybrid methods expand the range of applications available for timber construction. (Kaufmann, H., Krötsch, S. and Winter, S., 2018, pp. 40-42)

Timber in Germany

In Germany, where large areas of forests are found, there is a permanently available source of raw materials that should be managed sustainably. The forests fulfill numerous functions to protect climate and nature (it's a habitat for animals and plants, climate regulator, carbon dioxide storage, drinking water, and air filter), an area for recreational purposes, and an indispensable supply for Germany's economy as it supplies wood products and bioenergy. It is also a generator of jobs in rural areas with the paper and wood industry.

"Wood grows in Germany in very productive forests with high growth rates of over 120 million cubic meters per year. The forest in Germany is not overexploited but managed sustainably over many generations. For decades, more wood has been growing than is being used. As a result, large inventories have built up. With more than 3.74 billion cubic meters, Germany now has the highest wood reserves in Europe."(GD Holz, 2023).

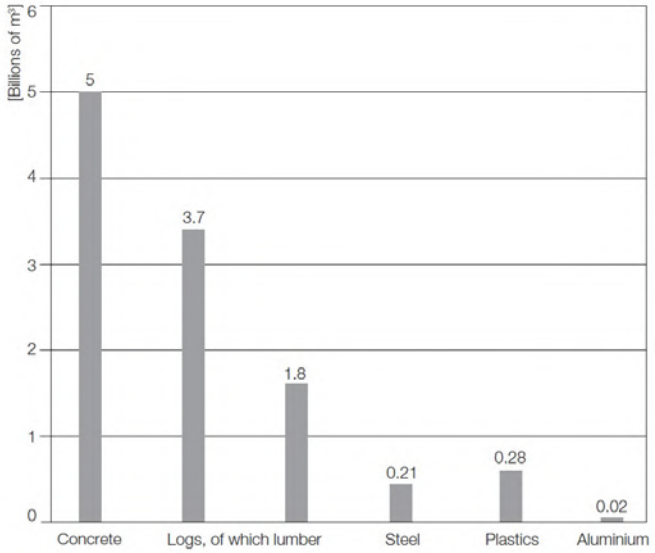

Figure 32: Comparison of use of different materials in construction

(Kaufmann, H., Krötsch, S. and Winter, S., 2018)

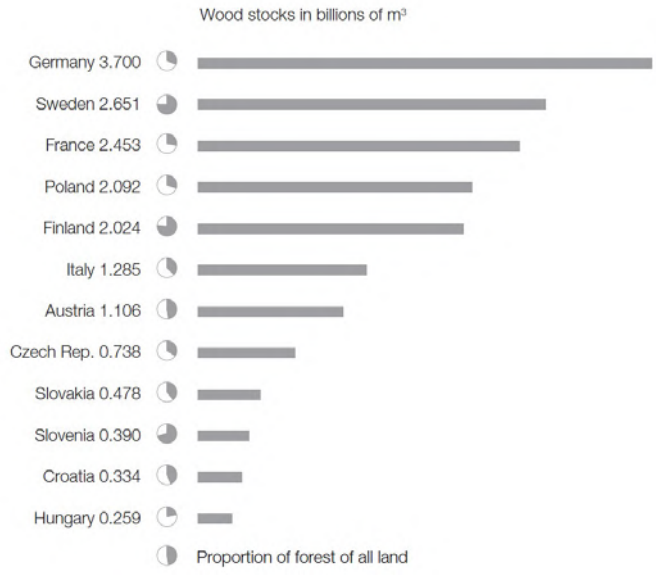

Figure 33: wood stocks in Europe.
(Kaufmann, H., Krötsch, S. and Winter, S., 2018)

References

Residential and office building

Location: Berlin, Deutschland
Architects:
Kaden Klingbeil Architekten, Berlin
Year of construction: 2013

Figure 34-35: photos of the project. (Kaufmann, H., Krötsch, S. and Winter, S., 2018)

Residential and commercial building

Location: Zurich, Switzerland
Architects: pool Architekten, Mathias Heinz, David Leuthold
Year of construction: 2010

Figure 36-37: photos of the project. (Kaufmann, H., Krötsch, S. and Winter, S., 2018)

Residential complex

Location: Jyväskylä, Finland
Architects: OOPEAA, Helsinki /Seinäjoki
Anssi Lassila (project leader)
Year of construction: 2015-2018

Figure 38-39: photos of the project. (Kaufmann, H., Krötsch, S. and Winter, S., 2018)

Residential complex

Location: Ansbach, Deutschland
Architects: Deppisch Architekten, Freising
Michael Deppisch
Year of construction: 2013

Figure 40-41-42: photos of the project. (Kaufmann, H., Krötsch, S. and Winter, S., 2018)

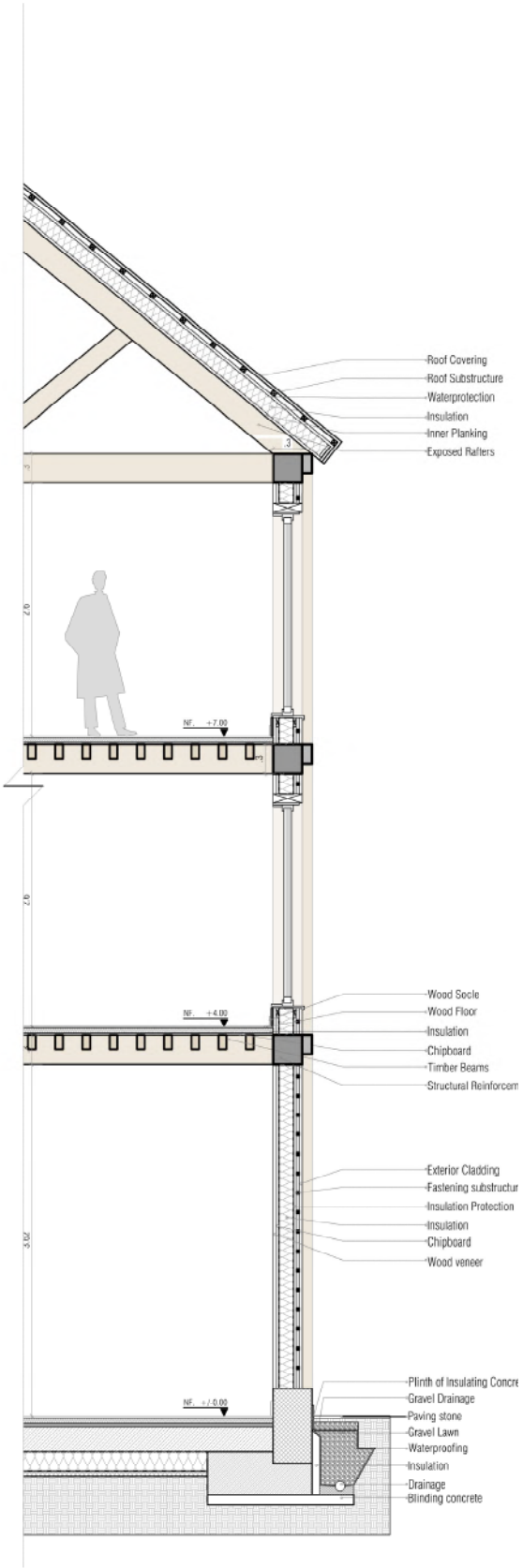

Figure 43: Detailed cross section of the facade of timber buildings. By author.

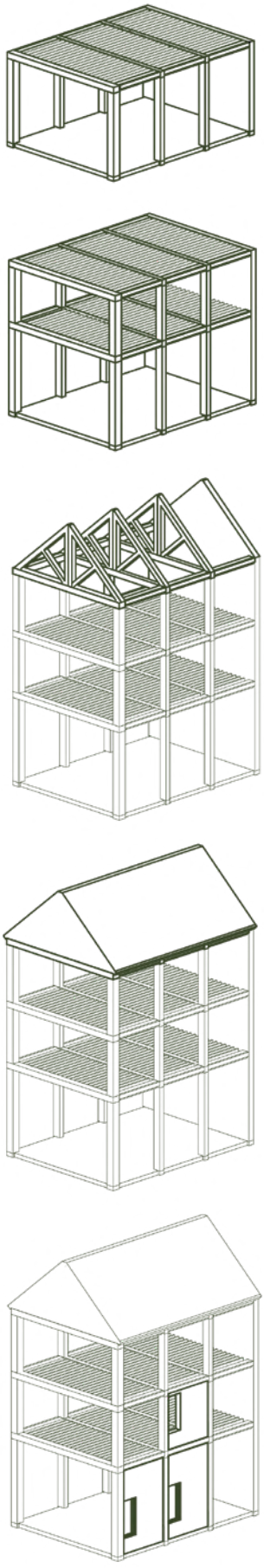

Figure 44: Diagram of the constructive system and structure of a timber building. By author.

3.3 Where does it come from?

The objective of using nearby materials is to reduce the environmental impact of the proposal on the surroundings. Therefore, the chosen materials were studied in order to find where they could be found and if they could really be called nearby.
To recall, the materials chosen are rammed earth and timber. Additionally, fibers from nearby crops can be used as additives to improve the earth mixture and as insulation in some cases.
The studied area covers a radius of ca. 9 km and both crops and sustainably managed forests were studied. The earth comes from the material excavated from the plot itself and it's improved with aggregates like fibers.

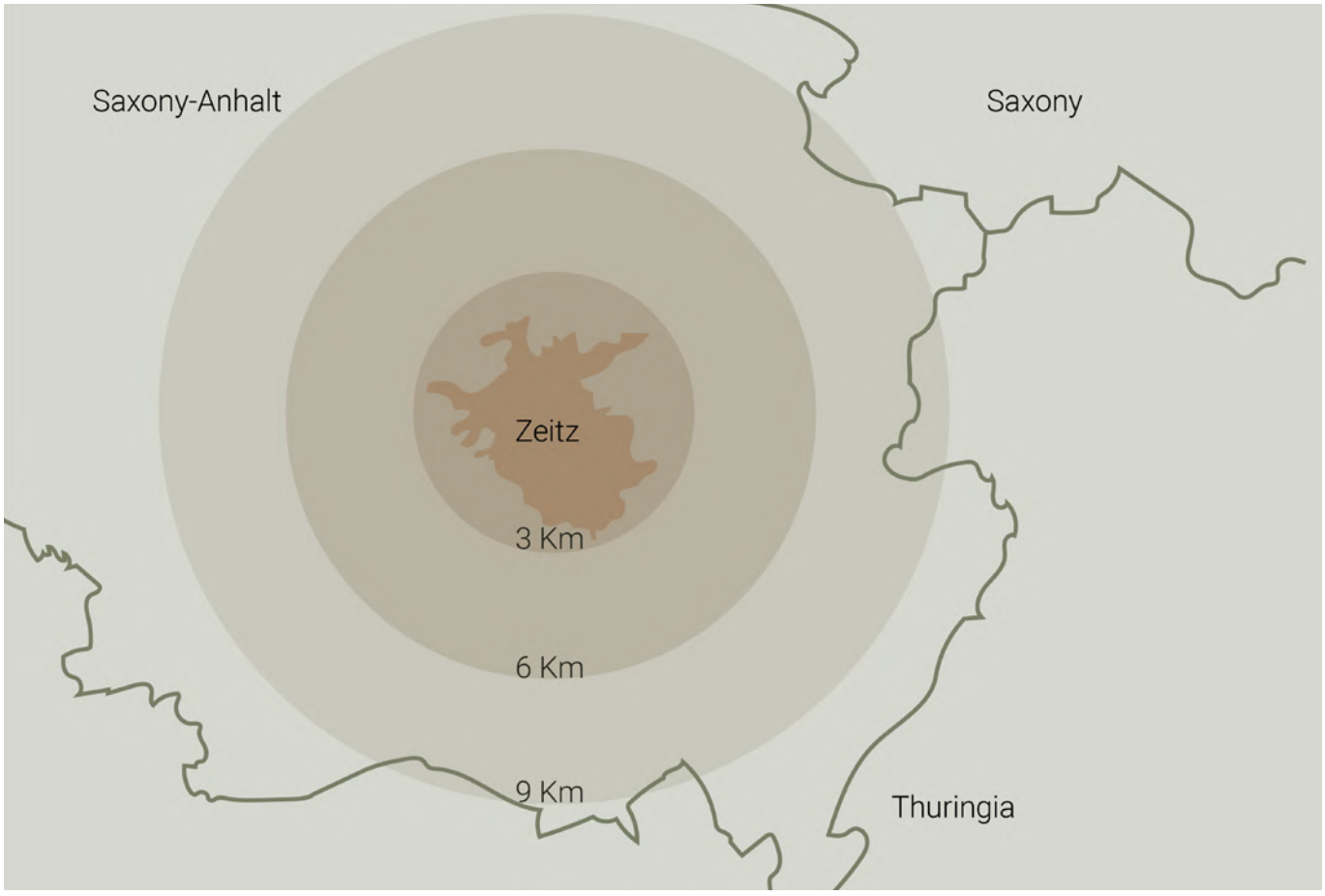

Figure 45: Location of Zeitz in the map and radius up to 9 km. By author.

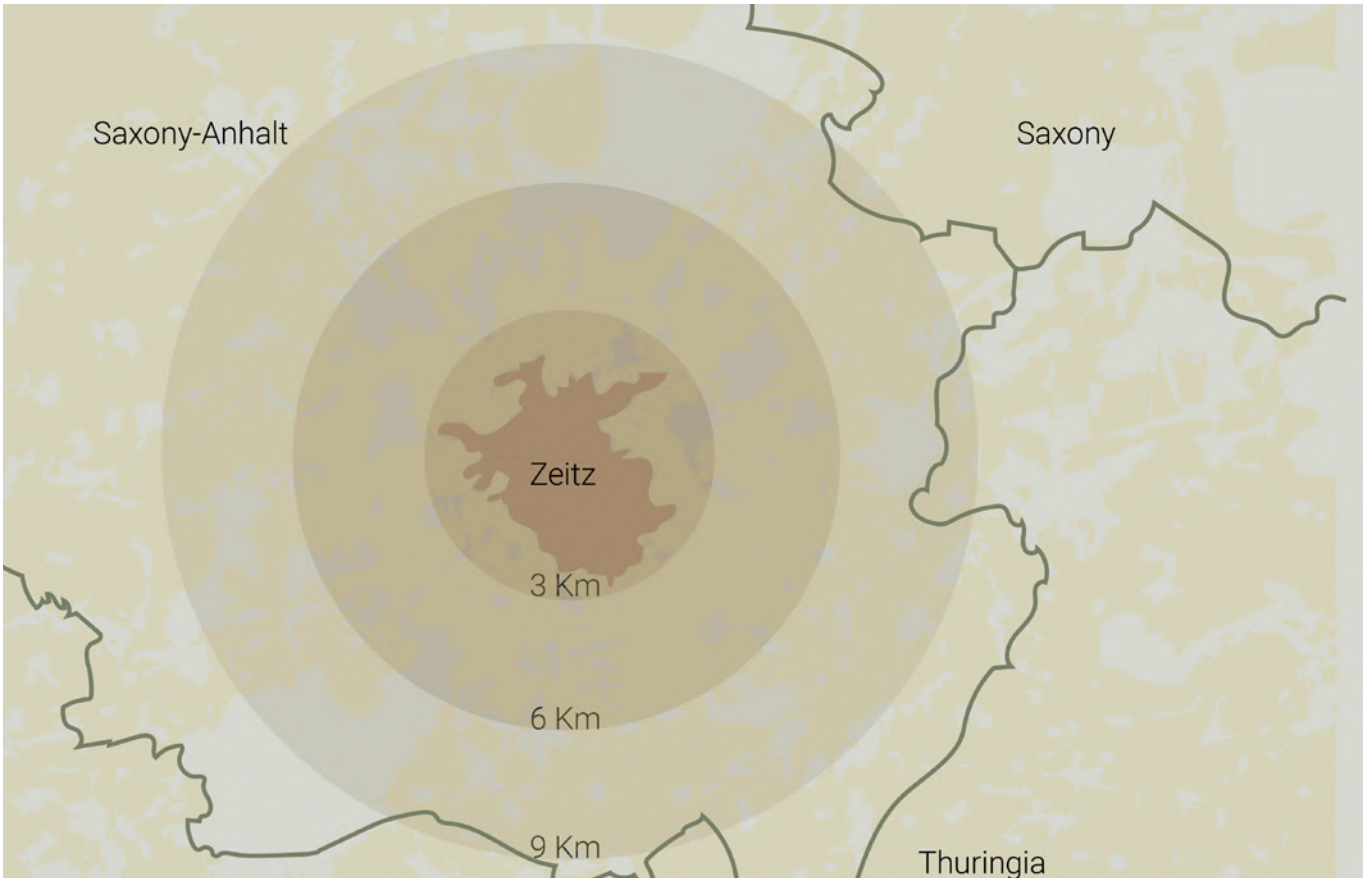

Figure 46: Areas with crops that can be used as fibers to improve the material. By author.

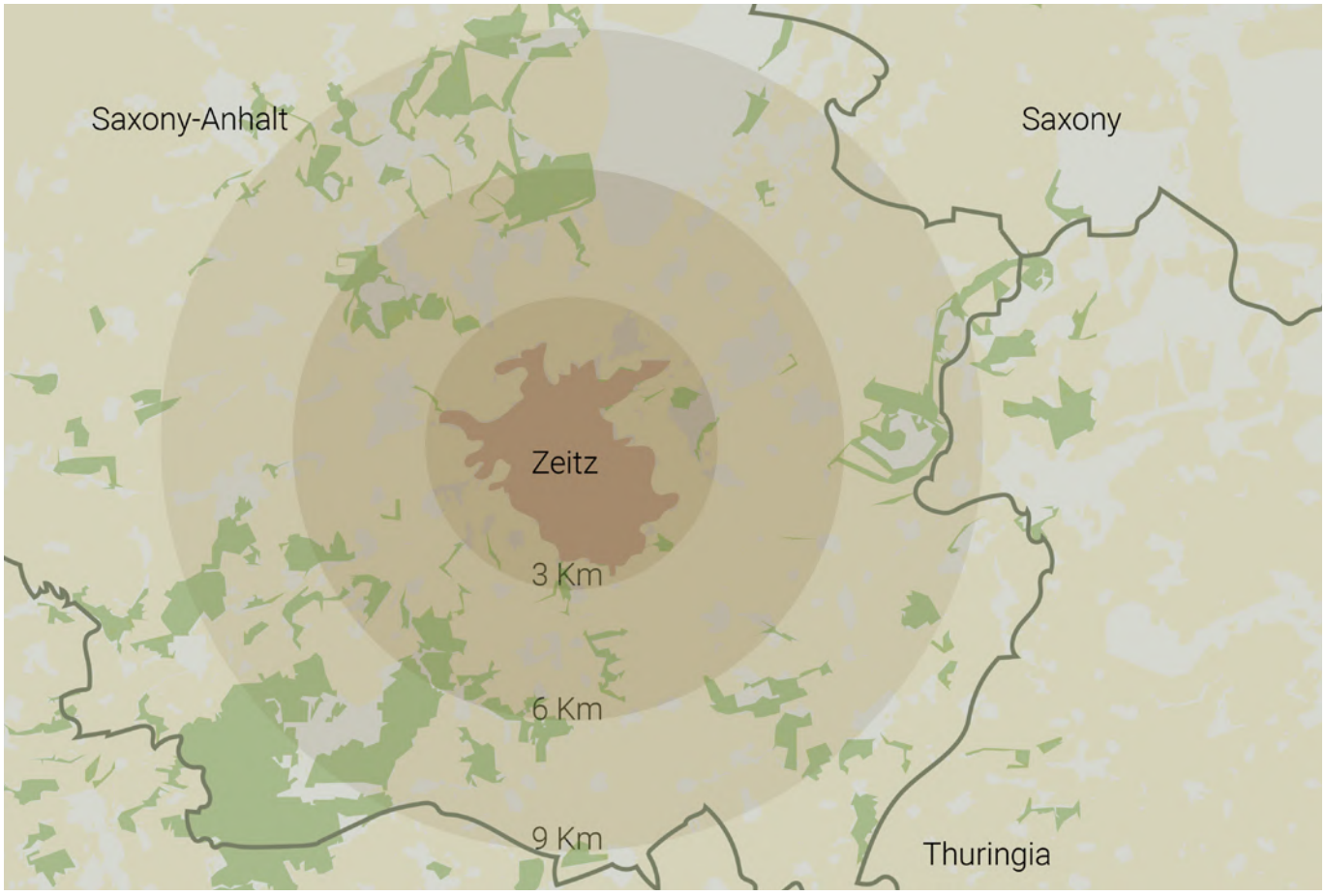

Figure 47: Areas with crops and sustainably managed forests . By author.

Information taken from:
https://www.arcgis.com/apps/mapviewer/index.html

CHAPTER 4
DESIGN PROPOSAL

4.1 Urban argument- concept

4.2 Uses and zoning

4.3 Plans, sections, facades

4.4 Renders

This chapter gathers all the research done in the past chapters and ends with the design of the proposal. This proposal is a result of a series of analyses, from concepts and spatial context to studying the nearby materials, and combines all the knowledge in order to come up with a solution for the problem stated.

The first part of the chapter talks about the concept of the project and the urban argument which become the guideline considered for the design process. It is further explained with conceptual diagrams.

It continues with the development of the zoning proposed and the uses chosen with the aim of revitalizing the area of Der Brühl. These uses have a direct influence on the functionality of the proposal and together with a good architectural design, a successful project is achieved.

Later, the architectural information is displayed in the form of plans and renderings which help the reader to better understand the project and to get the atmospheric feeling of the proposal. The materials chosen are highlighted in these documents to emphasize the use of nearby materials.

4.1 Urban argument- concept

Concept: Creating a Dynamic Center for the Revitalization of Der Brühl

The urban argument for this architectural project lies in the need to transform the center of Zeitz, in Der Brühl, into a dynamic hub that revitalizes the community and fosters sustainable growth. The architectural intervention, centered around the creation of public space and several buildings with different uses that respond to the public space, serves as a catalyst for urban renewal. addressing the challenges of population decline and migration to larger cities.

The argument is based on the idea that vibrant and inclusive spaces are essential for creating a thriving community which translates into a renewed Zeitz. This is achieved by integrating amenities such as a market, coworking areas, shops, cafes, and cultural spaces, in which the extension of these uses to the public space becomes a gathering point for socializing, commerce, and cultural exchange. This can enhance the quality of life for residents, while also stimulating economic activity.

Furthermore, the proposed intervention serves as an anchor for the overall revitalization efforts that are being done recently. By infusing the area with different activities, the project aims to fight the negative effects of the population decline, attracting new residents, businesses, and therefore, investment.

The urban argument is also supported by the need of preserving the towns' identity while achieving a sustainable project. With the use of nearby materials and sustainable design practices, the project holds environmental responsibility and establishes a strong connection to the local context.

To conclude, the urban argument for this architectural proposal is the creation of a dynamic center for the revitalization of Zeitz. With the intervention in the public spaces, the new uses offered, and the new activities injected into the dynamics of the town. The project aims to contribute to the local economy, improve social interactions, and overall, spark a revival of the town. Through a sustainable design approach, this intervention becomes a catalyst for positive change, by redefining Der Brühl as a thriving, inclusive, and economically vibrant place.

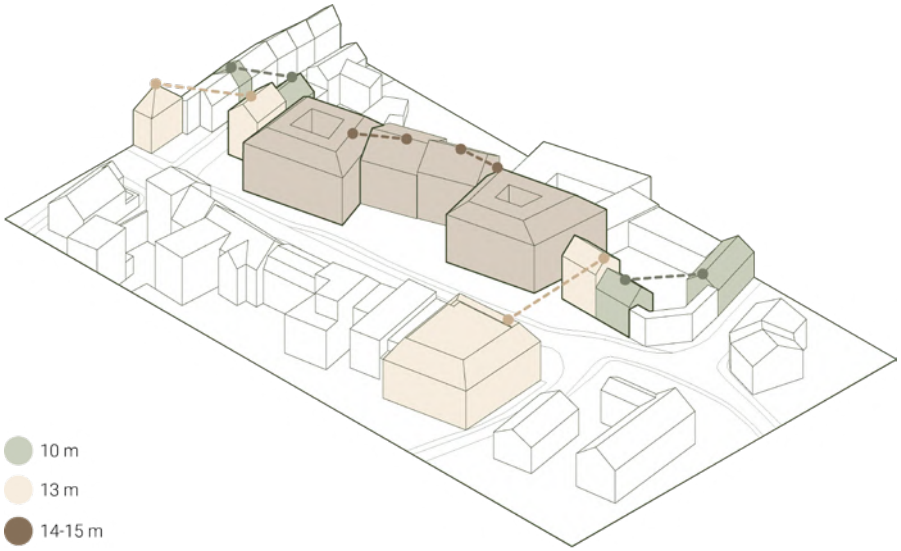

Figure 48: a study of the heights of the surrounding buildings.

The height of the surrounding buildings determined the height of the different buildings proposed. This was done in order to respect the existing context and to connect the project to it. The project aims to respect and become part of the existing skyline.
By author.

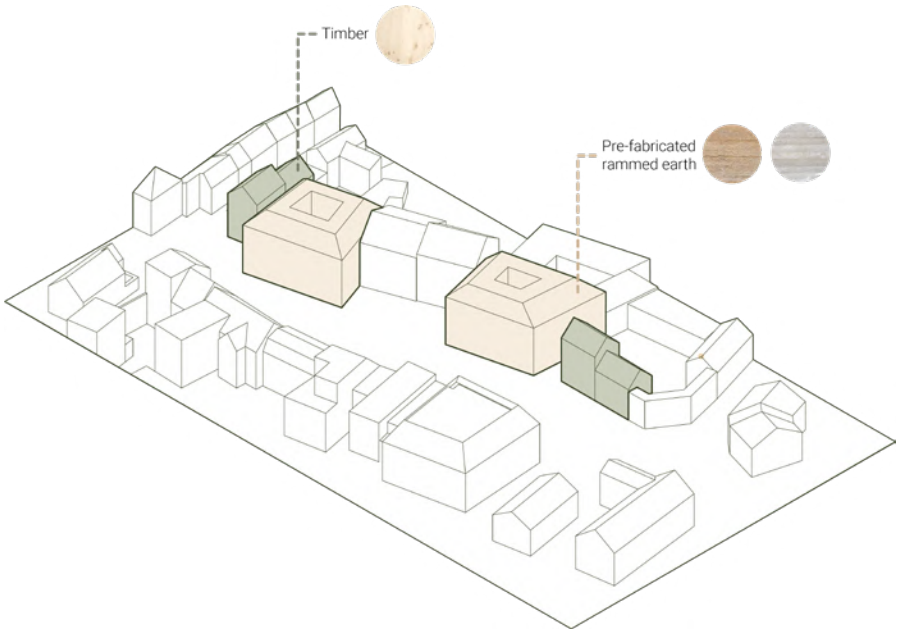

Figure 49: diagram of the proposed materiality.

Timber is widely used in the project as it is a nearby material that is easily found. It is used for the structure of the two central buildings and for the smaller buildings on the sides. For the central buildings, the earth taken from the excavation for the construction is used as rammed earth panels for the facades.
By author.

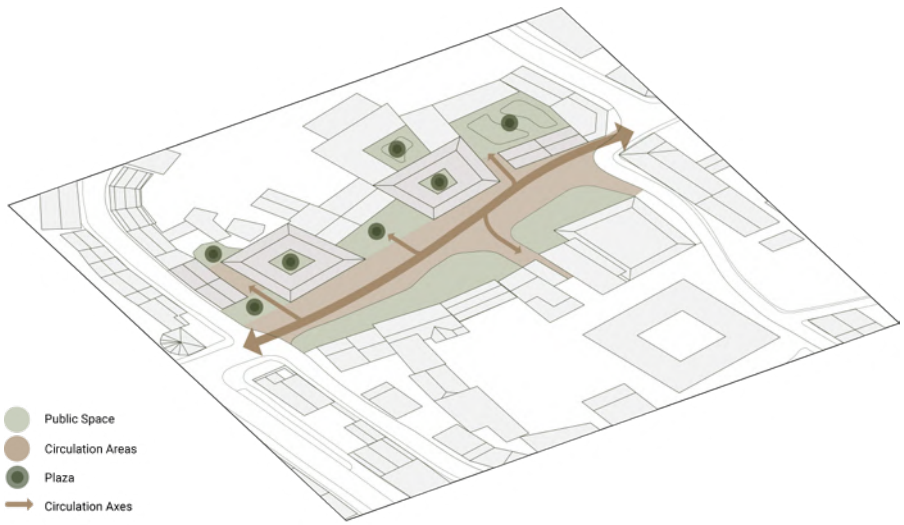

Figure 50: diagram of circulations, public spaces, and plazas.

The central circulation axis is achieved by adapting Der Brühl to a pedestrian-only street. There is a smaller vertical axis that serves as access points for the public spaces. There is a central plaza that highlights the existing buildings and additional smaller public spaces like courtyards to have semipublic areas.
By author.

Morphology

The existing morphology of the building of the town is mainly half-timbered houses. These are the typical German houses that make up the picturesque traditional towns. The basic geometry was studied and extracted in order to be used for the smaller proposed buildings in a contemporary way, which translates into the same shape and idea but contemporary facades and constructive systems. For the bigger buildings, the basic geometry was divided and turned around a central point to form a central courtyard with an abstract shape surrounding it. From the pedestrian point of view, the shape of the traditional house is respected

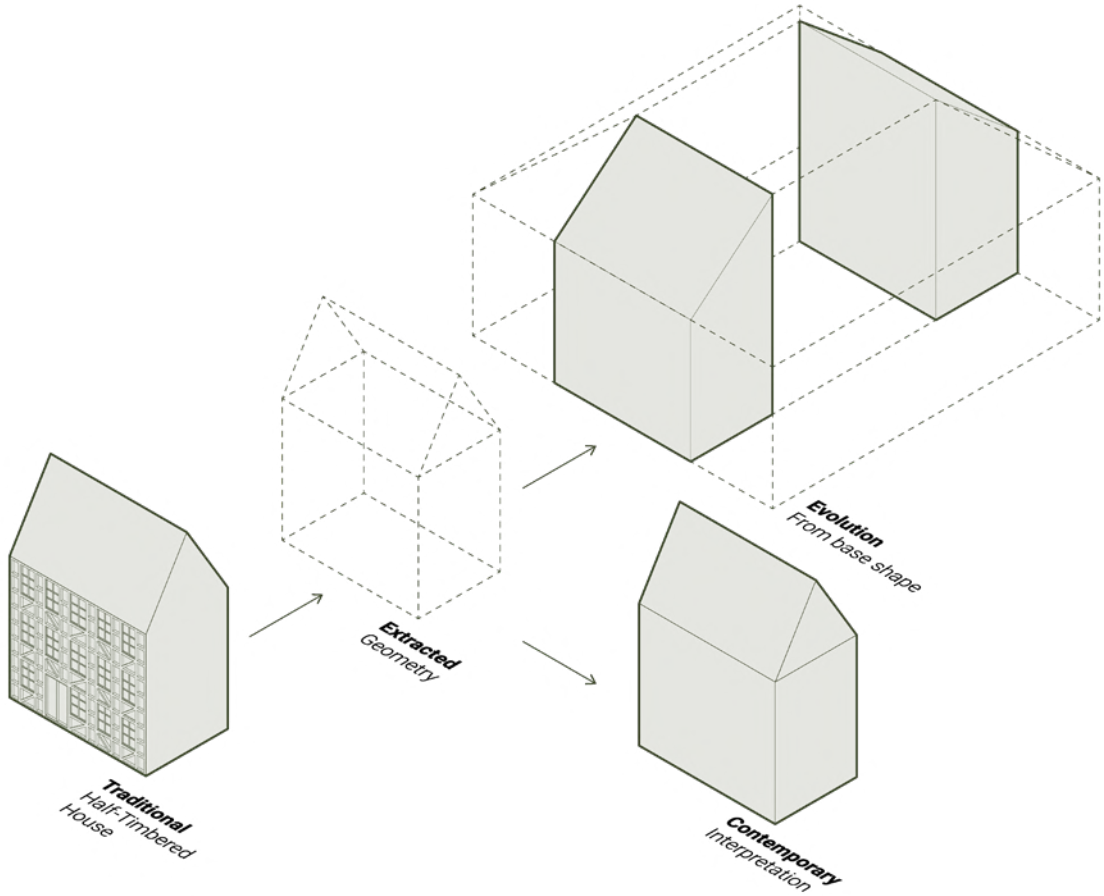

Figure 51: diagram- morphology analysis. By author.

Exploded isometric of how the facade works

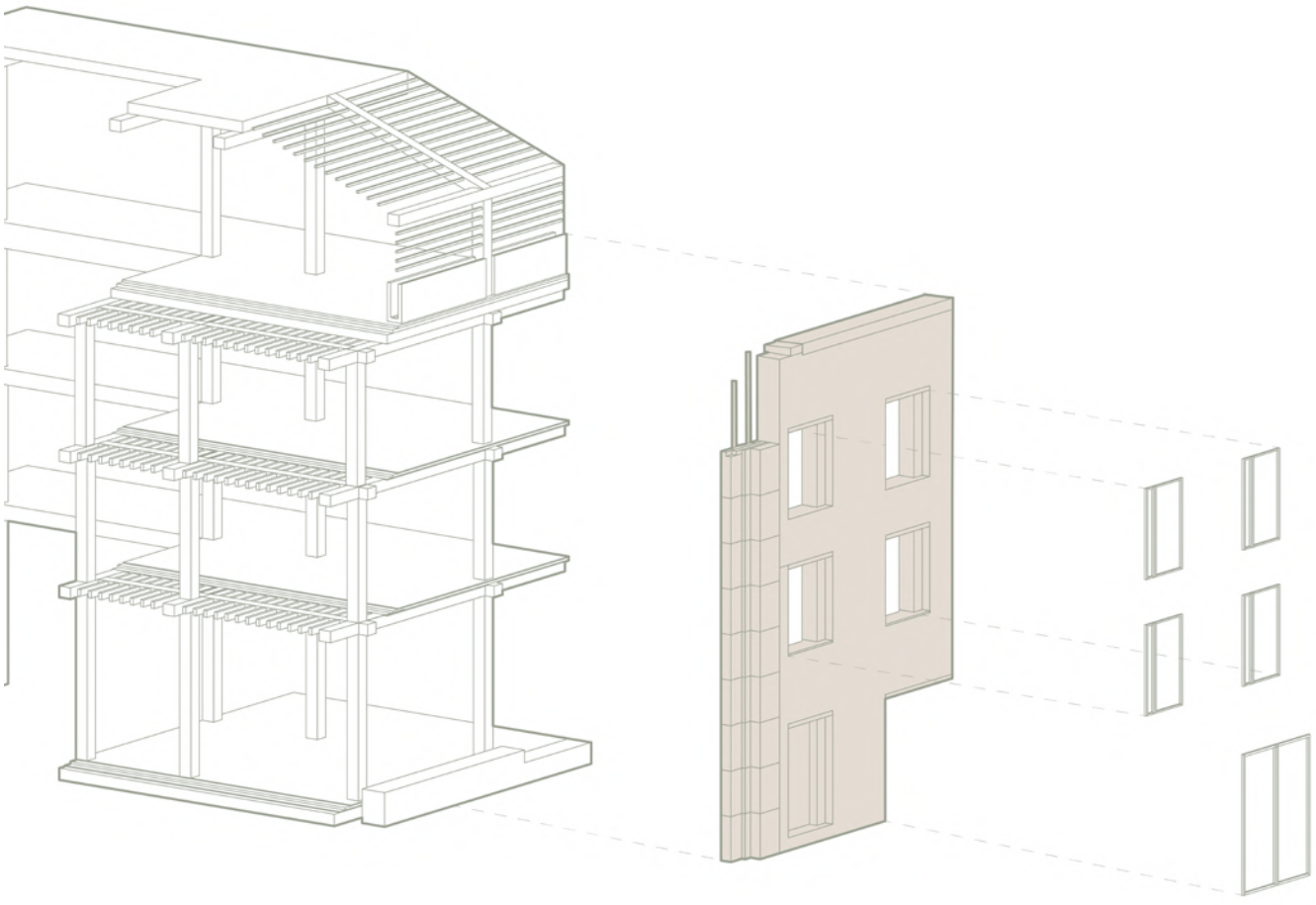

Figure 52: exploded axonometric of how the facade works. By author.

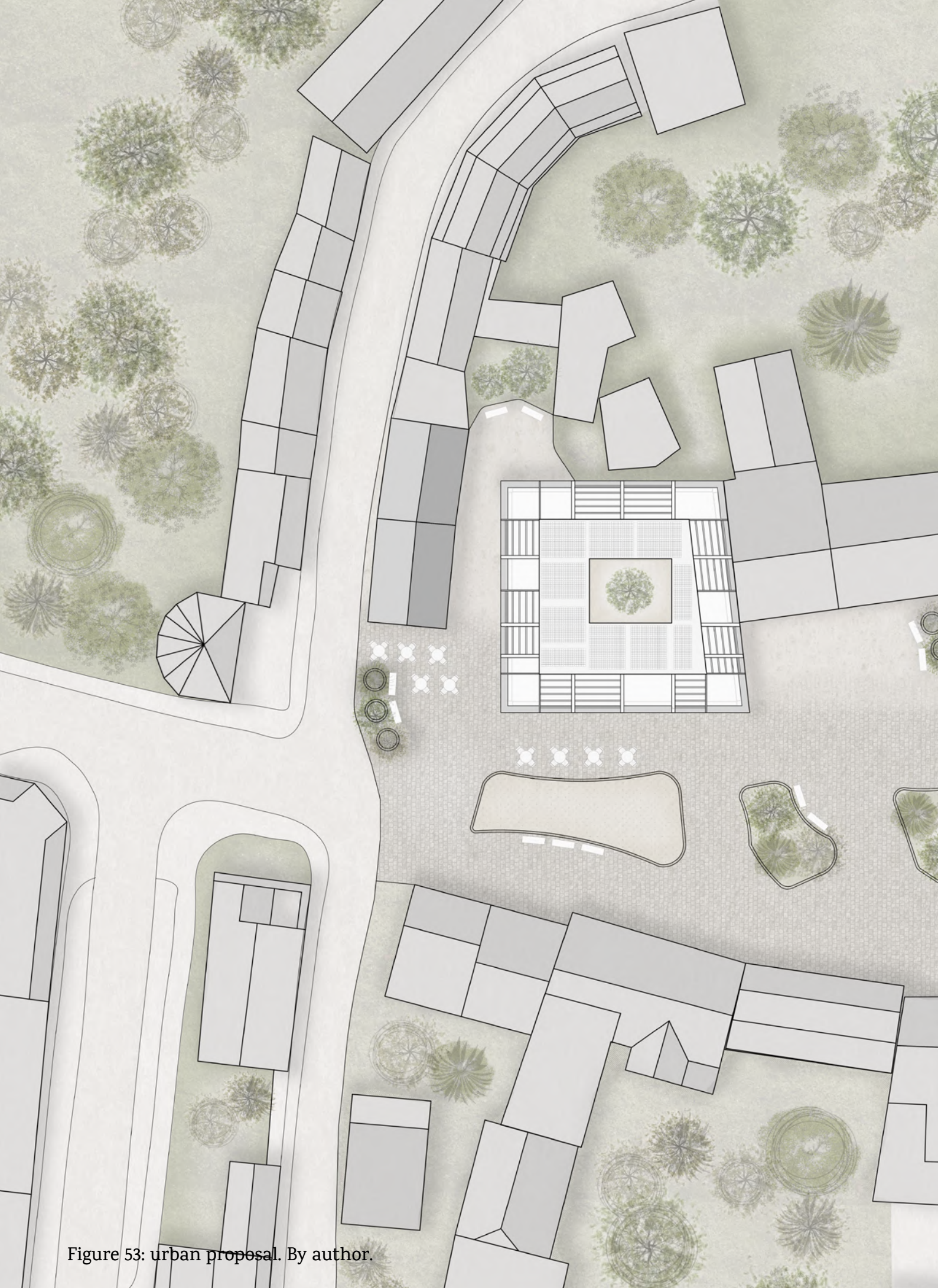

Figure 53: urban proposal. By author.


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4.2 Uses and zoning

The revitalization of Der Brühl is planned as a tool to turn the area into a vibrant community hub. To achieve this, it was necessary to explore strategies for activating the public and semi-public space, like different programming options such as markets, coworking spaces, shops, and cafes, that encourage social interaction and cultural exchange. In order to attract new residents to the area, different housing typologies are offered, from studios to family-like apartments for 4-6 people.
With the mixture of uses, diverse activities can take place to bring different types of users and inject life into the town.
The proposal has the potential to transform the town, not only for the residents but also for the larger community, fostering social cohesion, economic vitality, and a renewed sense of place.

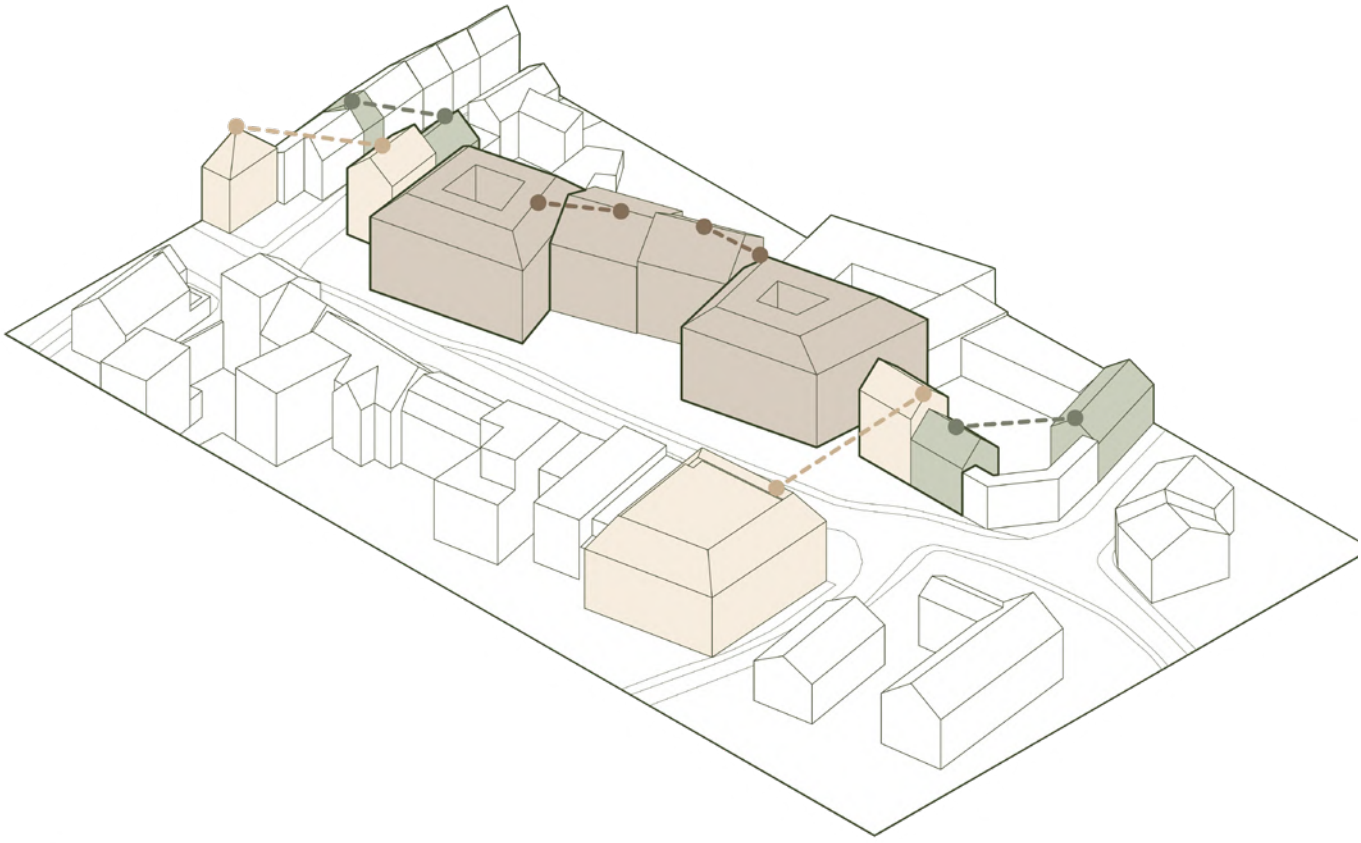

Figure 54: diagram of uses. By author.

Figure 55: axonometric view- highlighting public space. By author.

4.3 Plans and architectural documents

Figure 56: ground floor plan. By author.


MEETING ROOM
WC W
WC M
TECHNICAL
FLEXIBLE SPACE 2
FLEXIBLE SPACE 4
FLEXIBLE SPACE 3
COMMERCIAL AREA
COMMERCIAL AREA
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First Floor Plan

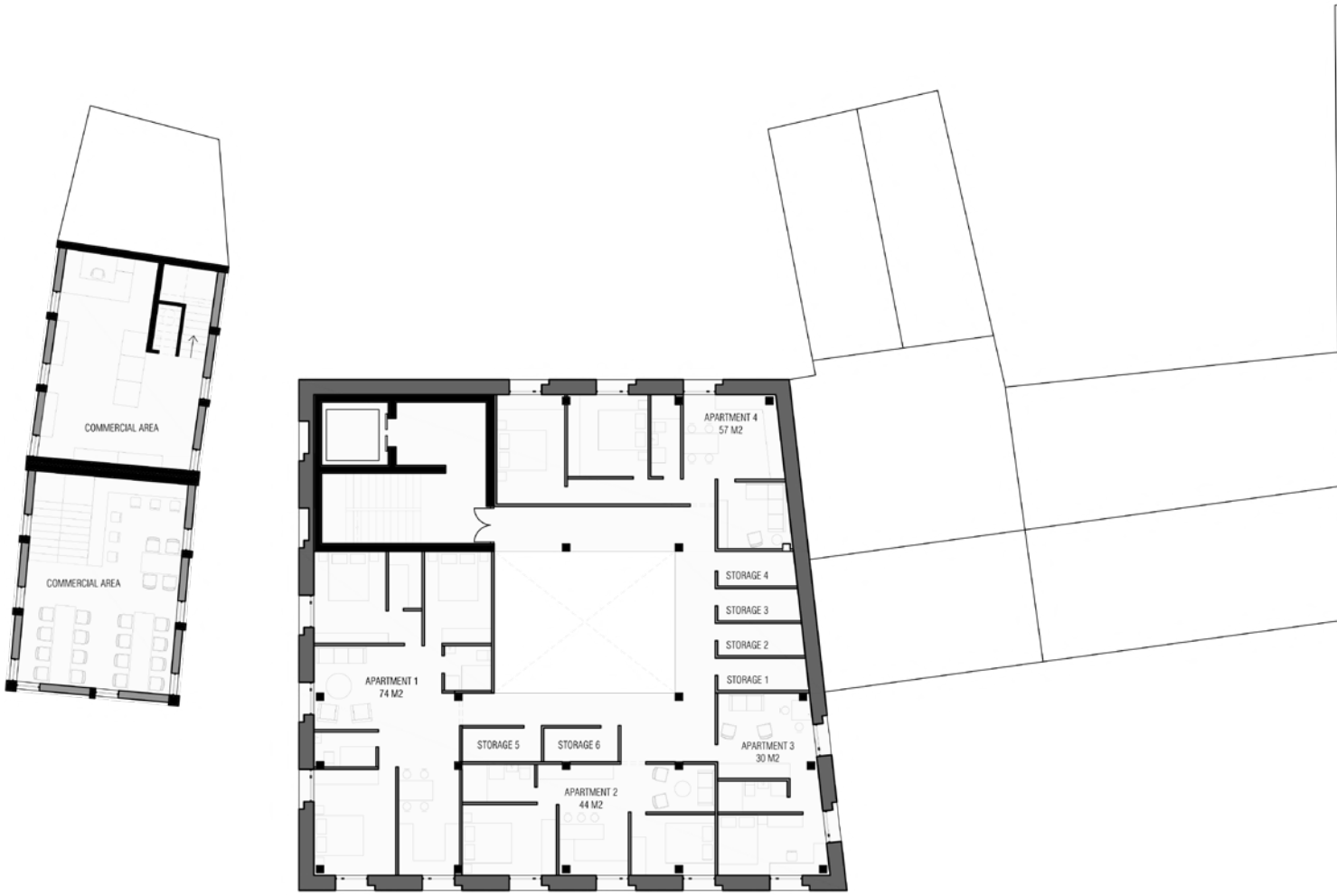
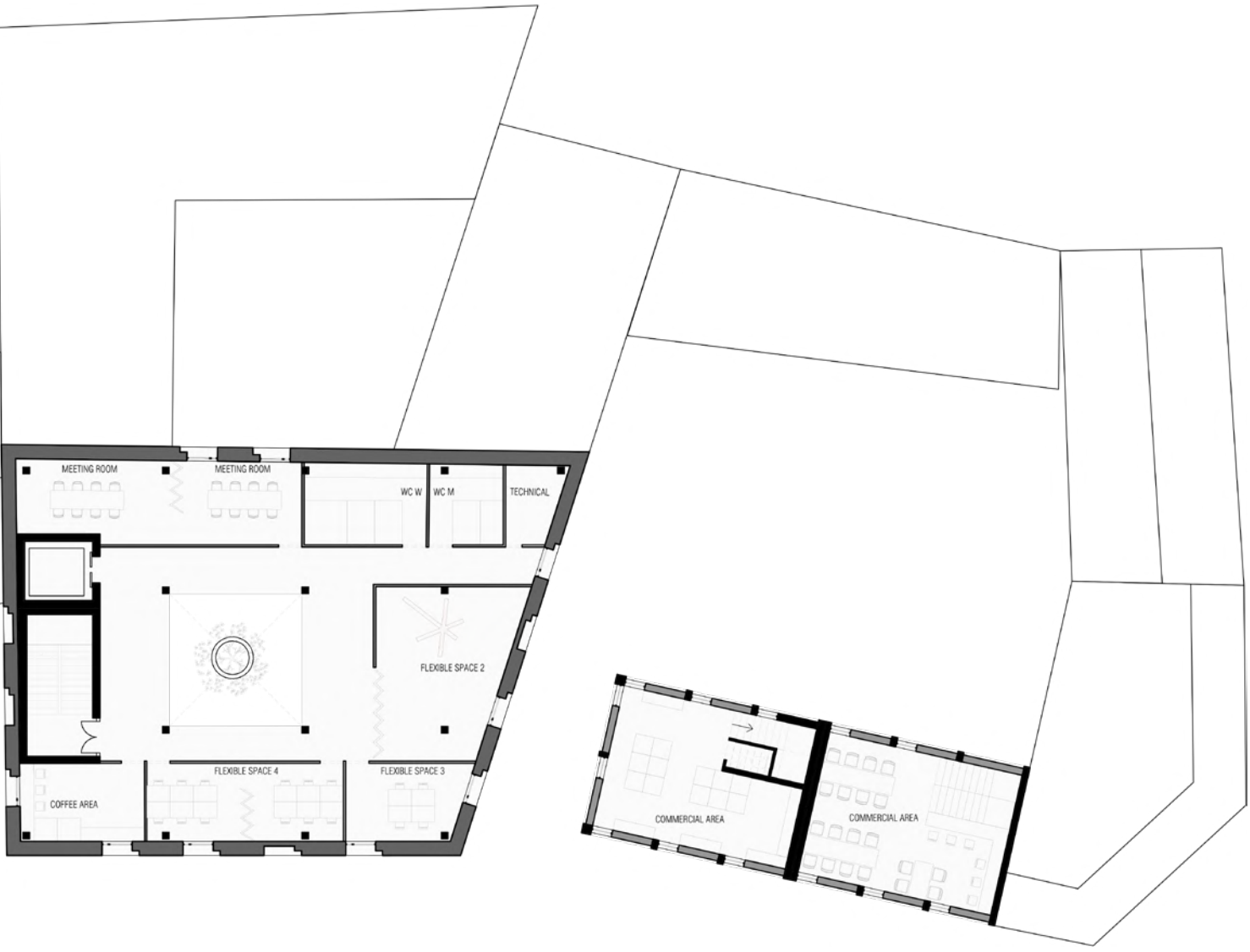


Figure 57: first floor plan. By author.


MEETING ROOM
MEETING ROOM
WC W
WC M
TECHNICAL
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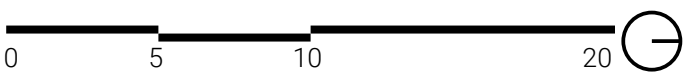
FLEXIBLE SPACE 3
COFFEE AREA
COMMERCIAL AREA
COMMERCIAL AREA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Second Floor Plan

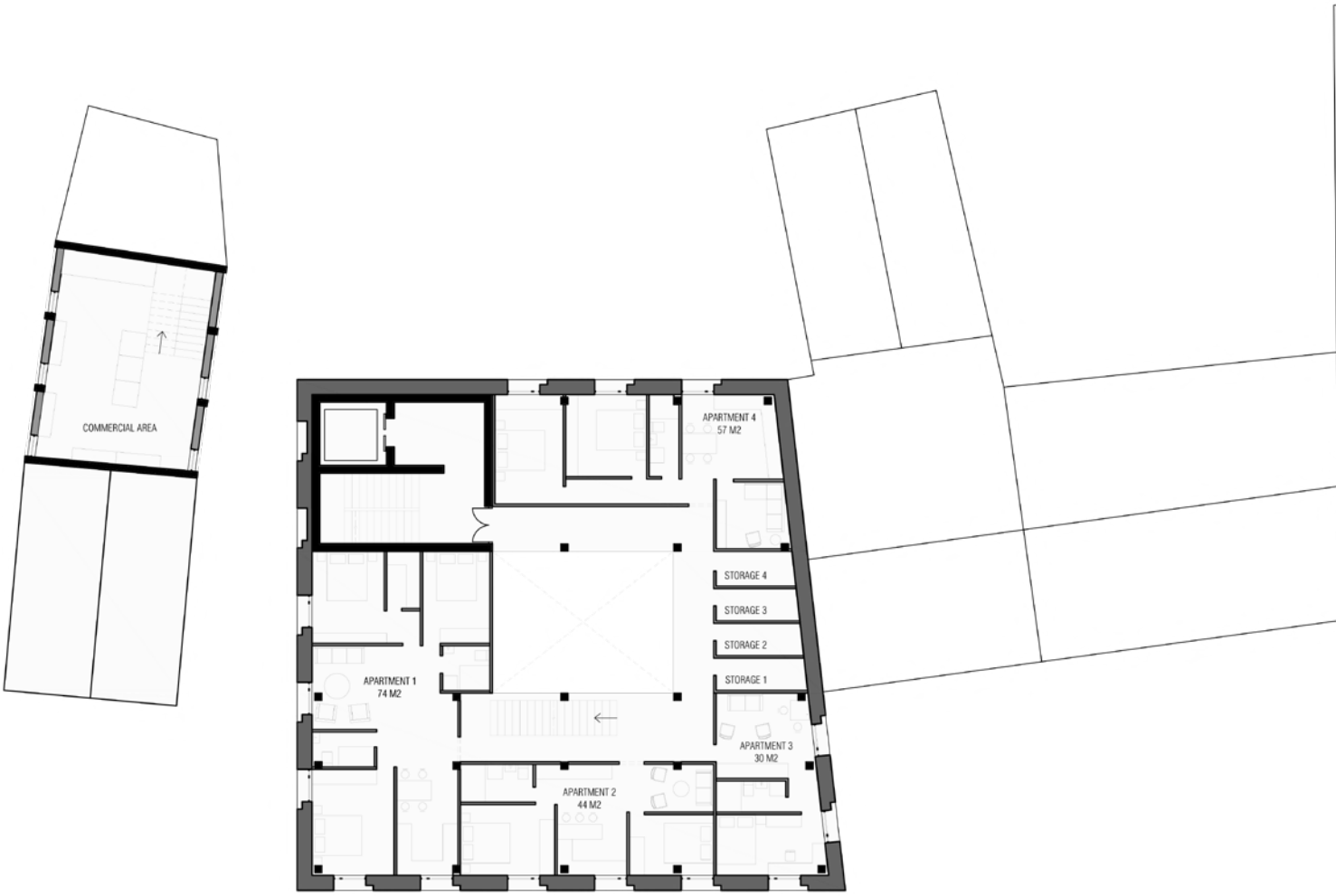
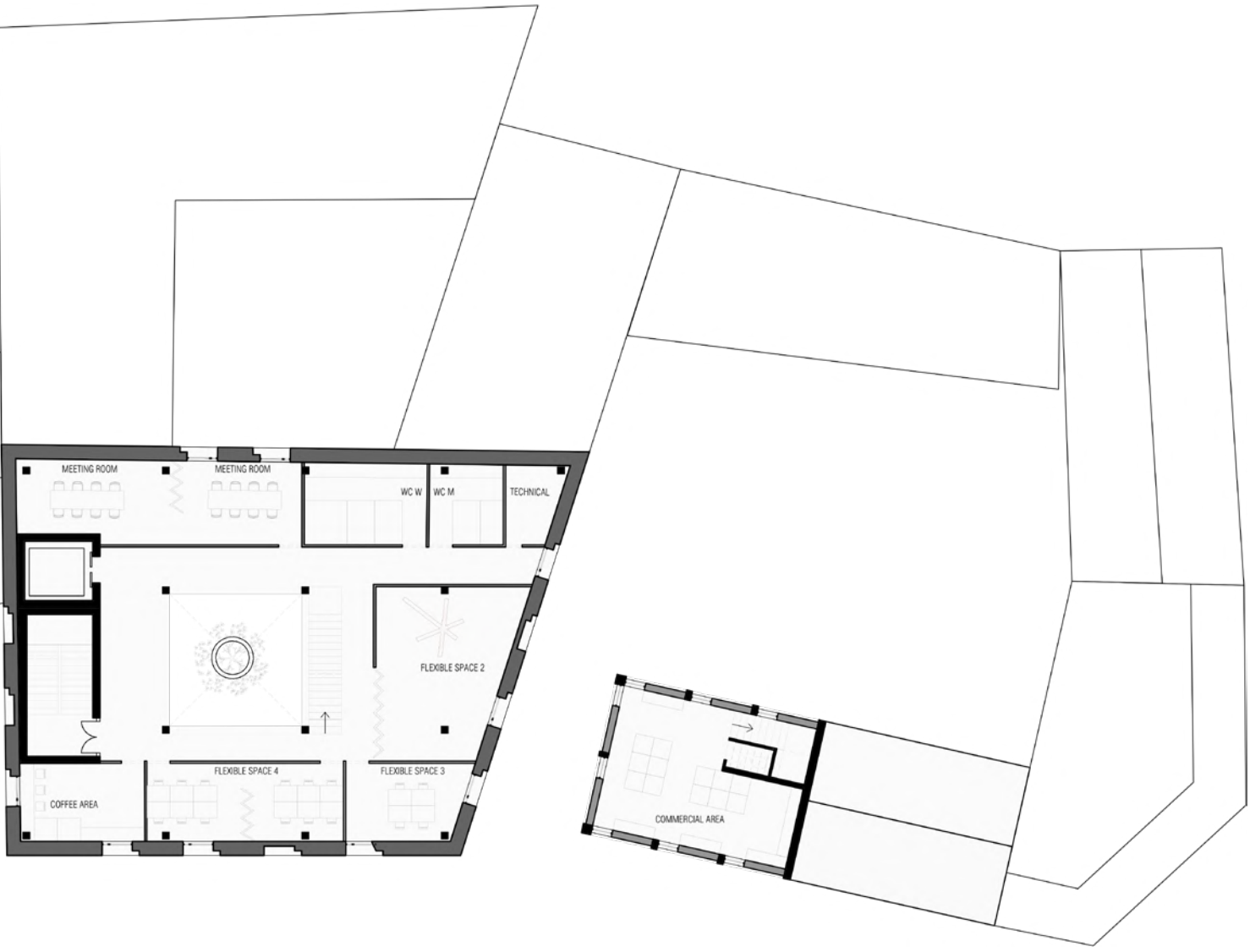
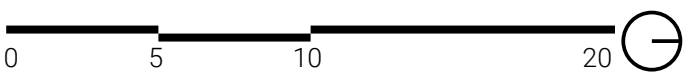


Figure 58: second floor plan. By author.


MEETING ROOM
MEETING ROOM
WC W
WC M
TECHNICAL
FLEXIBLE SPACE 2
FLEXIBLE SPACE 4
FLEXIBLE SPACE 3
COFFEE AREA
COMMERCIAL AREA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Rooftop Floor Plan

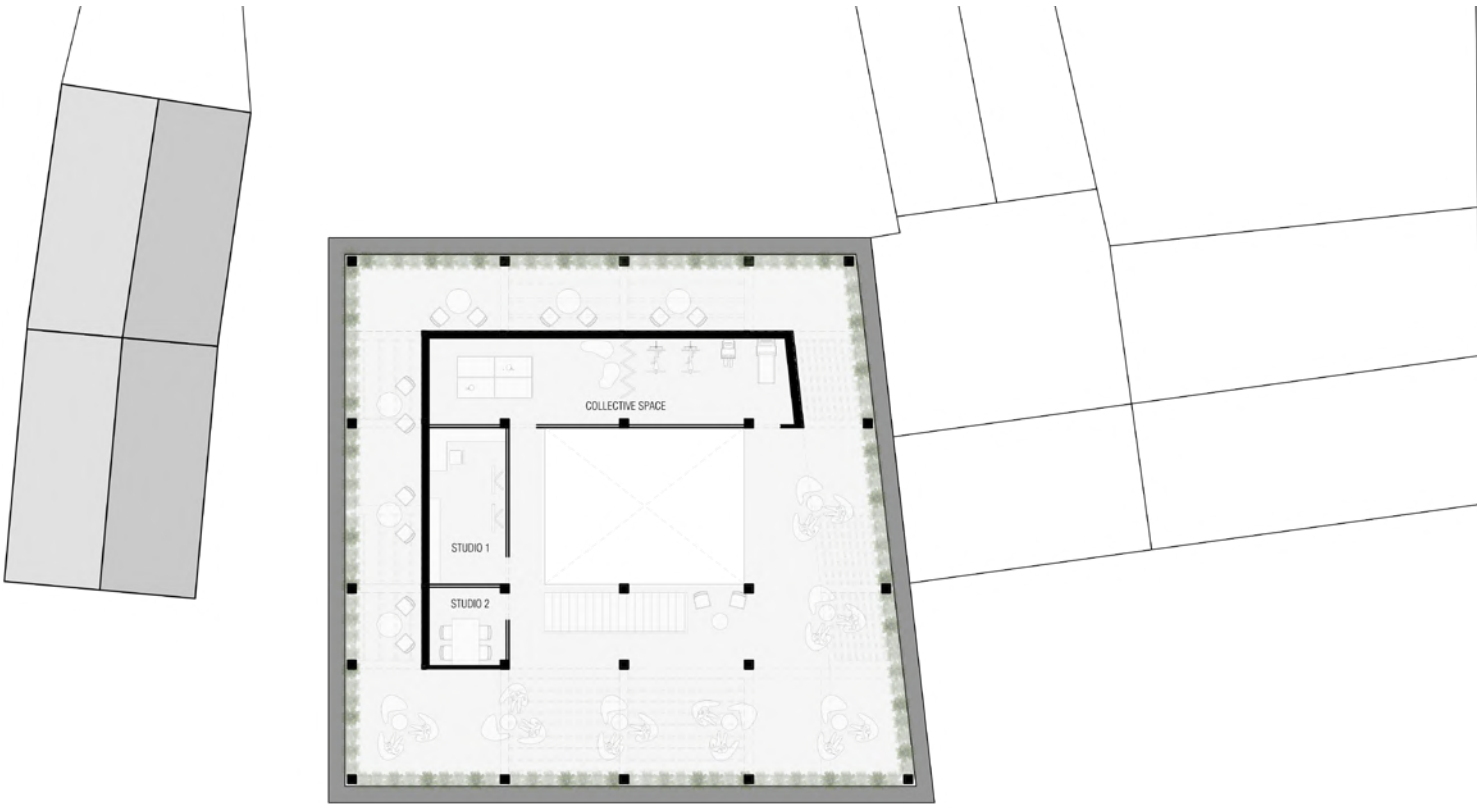
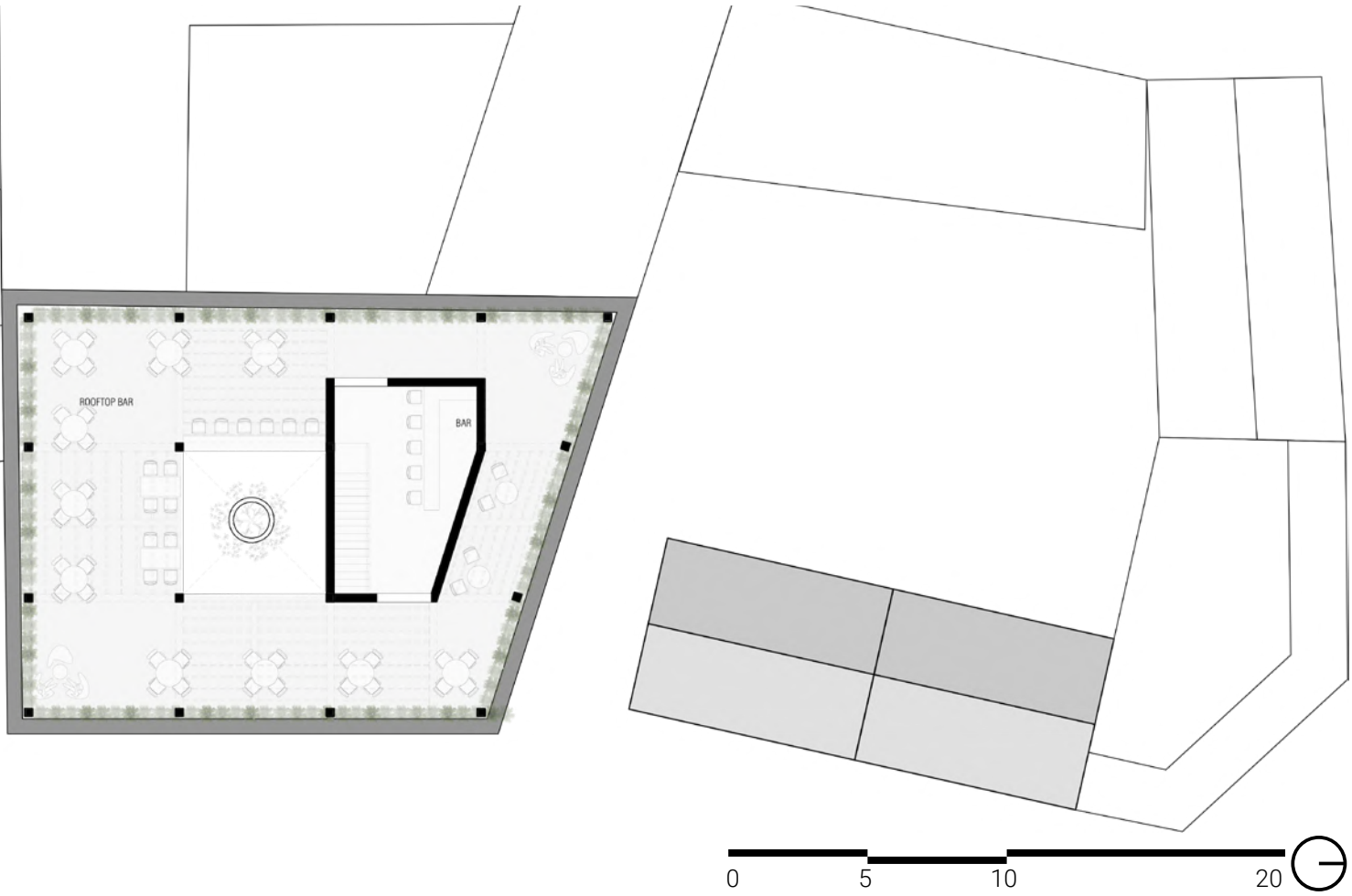


Figure 59: rooftop floor plan. By author.

Figure 60: urban section. By author.


ROOFTOP BAR
BAR
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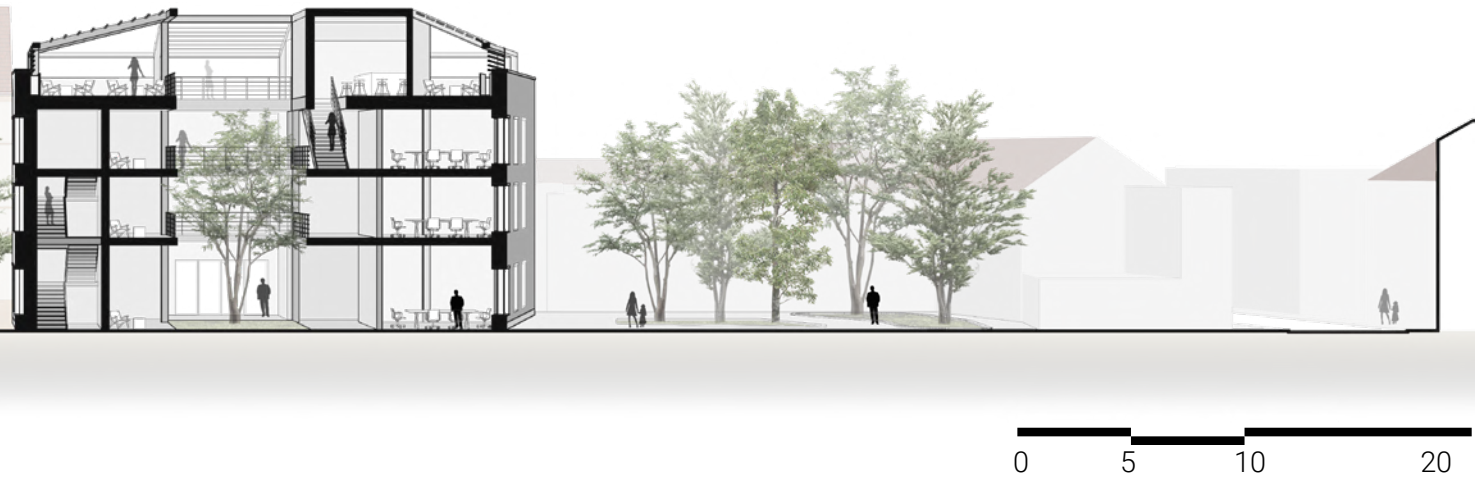
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4.4 Renders

Figure 61: render south entrance. By author.

Figure 62: render central plaza. By author.

Figure 63: render north entrance. By author.

5. Conclusion

The findings of this research demonstrate the potential of urban interventions in old towns and that using nearby materials is possible to reduce the environmental impact of the project. Through a comprehensive analysis of the spatial, cultural, and historical factors, as well as the integration of locally sourced materials, and sustainable design principles, this study shows the significance of creating inclusive, vibrant, and dynamic spaces to revitalize a specific area that can have a bigger impact on its surroundings.

The study of nearby materials allowed the author to find a viable solution to the problem of material sustainability, by using locally sourced materials like earth and timber. These materials also align with the analysed context of the town, in which historically, these materials were widely used but were forgotten over time. This research allows them, to reinterpret historical and contextual concepts and techniques and reuse them in a contemporary way which makes them competitive and valid in the architecture of today. The project demonstrates that with a deep analysis of the site conditions, both historical and physical, the architects can find the answer of what Is the better way to revitalize an area or the create new developments.

The proposed spaces which are commercial, housing, coworking spaces, cultural spaces, and quality public spaces, show promising results in addressing the challenges faced today by Zeitz. By offering a versatile and dynamic environment it has the potential to foster social interaction, enhance the quality of life for the residents, and stimulate economic growth. Furthermore, the integration of nearby materials has not only contributed to the sustainability of the proposal but also celebrated Zeitz unique identity and architectural and cultural heritage.

Through community engagement and stakeholder involvement, it is possible to positively impact the community. These new valuable spaces create a sense of ownership, pride, and increased social connections in the town. The public spaces, semi-public spaces, and private uses can become focal point for various activities, providing opportunities for local businesses to thrive and encourage both residents and visitors to actively participate in community life.

As for the future, it is important to continue fostering community engagement and maintaining public and semi-public spaces to sustain their impact over time. Ongoing efforts should focus on adaptive reuse strategies, encouraging the local community

to actively contribute to the programming and management of the spaces. This will ensure that the project remains responsive to evolving needs and aspirations of the town and its community. Additionally, this intervention could become a starting point and example for future urban developments with the same aim of revitalizing decayed areas with a sustainable approach and cultural preservation.

In conclusion, this research has underscored the transformative potential of public spaces, semi-public spaces, and private spaces with various uses as a powerful tool for revitalizing Der Brühl, in the context of a traditional German town with a lot of history and cultural heritage. By carefully considering the spatial, cultural, and historical factors, and embracing sustainability and community engagement, these spaces can create vibrant, inclusive, and resilient communities. The findings gained from this research contribute to the broader discourse on architecture, urban revitalization, and sustainable development, inspiring future research and encouraging the implementation of similar interventions in other communities.

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Thesis : Wood and Earth as building materials for the redevelopment of Zeitz

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